SHARED MOBILITY: THE FUTURE OF PUBLIC TRANSPORT

A THESIS SUBMITTED IN FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF SCIENCE IN GEOGRAPHY
BY

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2019

Abstract

In Christchurch, public transportation (**PT**) has not eased pressure off private car ownership. With Christchurch's population set to increase in the near future, the transport system needs to adapt to be able to support the mobility of the local population.

My research considers how shared mobility can support PT in Christchurch. I interviewed policymakers to understand what factors are affecting low PT usage. I interviewed shared mobility operators to understand their perceptions about shared mobility. Finally, I ran an online survey for the Christchurch community to understand how they use transport and shared mobility in Christchurch.

I found various factors contributing to low PT usage in Christchurch which included lack of accessibility, inadequate frequency of service, poor availability of service, inconvenience of use, long transport times, a poor perception of PT, the issues posed by Christchurch's medium to low population density, the cost of PT, a culture of car dependency and the cost-ineffectiveness of providing PT in some areas. Shared mobility showed potential to support PT in that it can be more environmentally friendly, help reduce congestion and be more economical. However, there are many barriers to its success in Christchurch. The survey highlighted that the key barriers are a lack of information about shared mobility, safety and privacy concerns about its usage, a reluctance on the part of potential customers to use credit cards for bookings, and unavailability in the locality. These factors make the future of shared mobility in Christchurch uncertain. Future research has to explore how shared mobility can address the deficits in the current PT system and the possibility of integrating access to PT and shared mobility through on-demand app-based systems.

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Glossary

Public Transport (PT)	PT refers to systems of different vehicles (e.g. buses, trains, trams, boats, ferries and many others), which are available for the general public to use on a daily basis. New definitions are also now starting to add shared transport, park & ride and demand responsive transport to the definition under PT (Ministry of Transport, n.d.).
Shared Mobility	Shared Mobility allows users to gain short-term access to different modes of transport to get from one place to another on a need to basis (Shaheen, et al., 2015).
Bike Share	Bike-Share allows users to rent a bike in an hourly or daily fashion for a fee. Bike-Share systems generally use dock-based stations that are distributed throughout the service area for users to use and return to a station (SUMC, 2015). New forms of bike sharing are dockless or GPS based systems.
E-Scooter Share	E-Scooter Share allows users to share scooters for a round trip or one-way trips. Users pay a small fee for using the electrical scooter without owning a scooter.
Car Share	Car-Share is similar to bike-share as it allows users to access vehicles on an hourly basis with an extra cost per kilometres as free mileage is capped

	(SUMC, 2015). Popular types of car sharing include one way, point to point and round trip.
Ride Share	Ride-Share allows users to add passengers to their pre-existing trips There are a few different types of ride sharing systems but the most used are carpooling, vanpooling and real-time dynamic ridesharing (SUMC, 2015).
Ride Sourcing/ Ride Hailing or Ride Splitting	Ridesourcing/Ride-Hailing or Ride-Splitting are systems which allow their users to connect with their drivers through the online app and the drivers generally use a private vehicle (SUMC, 2015). Ride Splitting allows users to split the cost of travel.
Policymakers	One who plans and formulates policies for a business or government.
Shared Mobility Operators	Someone who manages and runs the current systems.
Mobility as a Service (Maas)	A customer focused on demand mobility service aimed to bring the integration of all forms of transport under a single form of service. A single application is accessible for all to use for though one payment network rather than various different networks.

Acknowledgements

I am grateful to Dr Angela Curl and Professor Simon Kingham, my research supervisors, for their guidance and critique of my work. I also thank my lecturer Rita Dionisio for her advice.

Many individuals and organisations have supported this study and made it possible. Claire Fletcher helped me refine my survey and Julieana Findlay set up the distribution of the online survey. The cooperation, encouragement and insights of the following individuals were invaluable: Edward Wright and Jeremy Dickson from Environment Canterbury, Nicholas Lovett from the Christchurch City Council, Lucia Sobiecki from the Ministry of Transport, Russell Turnbull from Go Bus New Zealand and Kirsten Corsen from Yoogo Share.

Finally, my close family and friends have supported me and borne with me throughout the past year and half. I thank them for their patience and encouragement.

Chapter 1: Introduction

Public transport (**PT**) is not working well in Christchurch. The impending population growth, rising fuel prices and deteriorating environment quality mean that the current preference for private vehicles in Christchurch is not going to be a sustainable solution in the future. My research explores the potential for shared mobility to supplement the existing PT system and provide a user-friendly alternative to car dependency in Christchurch. It identifies issues with shared mobility that will need to change if it is to become a feasible option for Christchurch.

1.0 The issues with private car usage

The 2013 Census showed that private car usage is the predominant form of transport in Christchurch and the surrounding districts (StatsNZ, 2003). Eighty-four percent of people commuted to work on census day with either a car, van or truck and from that, 64.1% of people used private cars (StatsNZ, 2013).

However, Christchurch's preference for private car usage is likely to pose numerous challenges in the near future. This is because private car usage is ill-suited to the impending population growth, has an adverse impact on the environment and may not be sustainable in light of rising fuel prices.

The current world population is expected to grow from 7 billion to around 8 billion by 2024 (Roser and Esteban Ortiz-Ospina, 2018). The urban world population sits at 3.9 billion and is expected to grow by another 2.5 billion by 2050 (United Nations, 2014). Christchurch's current population is estimated to be around 388,400 (ccc.govt.nz, n.d.). This will increase the population to 424,400 by 2028 (ccc.govt.nz, n.d.), namely by around 42,000 inhabitations.

Population growth often results in urban sprawl, which in turn affects private car usage. Many people move to the outskirts of the city and travel in from suburban areas to work. This process has led to an increase in travel times and is one of the reasons why private car usage have become more convenient for individuals (Mezghani, 2005). Private car usage, however, leads to an increase in congestion (Chapman, 2007). Congestions increase travel times and have adverse impacts on worker productivity (Hartgen & Gregory Fields, 2009). They also decrease amenity for road users. Christchurch is also experiencing urban sprawl, as is evident from the growth

of “satellite” townships around Christchurch such as Pegasus, West Melton and Rolleston. Commuting to and from these satellite townships is likely to pose similar issues of congestion for Christchurch’s road users.

Climate change poses another problem for private car usage. Transport usage is one of the main contributors of greenhouse gas emissions, which causes global warming. ECAN (2018) state that transport contributes to at least 19% of New Zealand’s greenhouse gas emissions. From 1990 to 2015 road transport emissions in New Zealand have risen by 78% (Ministry for the Environment & Stats NZ, 2017). The Intergovernmental Panel on Climate Change (IPPC) (2018) found that an expected increase of 1.5°C in as little as eleven years will have major impacts on our world unless CO_2 emission is drastically cut down. Private car ownership will have to be avoided due to the high amounts of CO_2 emissions (Chapman, 2007 and Waterson, Rajbhandari and Hounsell, 2003).

Rise fuel price will pose another challenge. As "Peak Oil" is the depletion of our global oil production of cheap oil or otherwise known as conventional crude oil (Wirth, 2008. pg. 4). Oil is a non-renewable resource (Wirth, 2008) and peak oil will lead to rising fuel prices (Towne, 2009). In the near future, the worldwide demand for conventional crude oil will exceed what could possibly be provided (Towne, 2009). Therefore, reducing the number of private vehicles needs to become a priority.

2.0 The problems of PT

PT would be the solution to many of the failings of private car usage. However, PT usage is unpopular in Christchurch compared to car usage (both Christchurch City and Greater Christchurch). In this section, I overview the current PT system in Christchurch, its potential benefits and the problems that currently make it unpopular compared to private car usage.

The current PT system in Christchurch is purely dominated by buses, with the only other form of PT being one ferry, which connects the port Lyttelton with the suburb Diamond Harbour. The bus network currently consists of five core routes (Figure 1). These are “the Orbiter”, “Orange Line”, “Yellow Line”, “Purple Line” and “Blue Line” (ECAN, 2018 pg. 20). These core services connect two or more key activities centres together, refer to, (Table 1) for more detailed information about each core route.

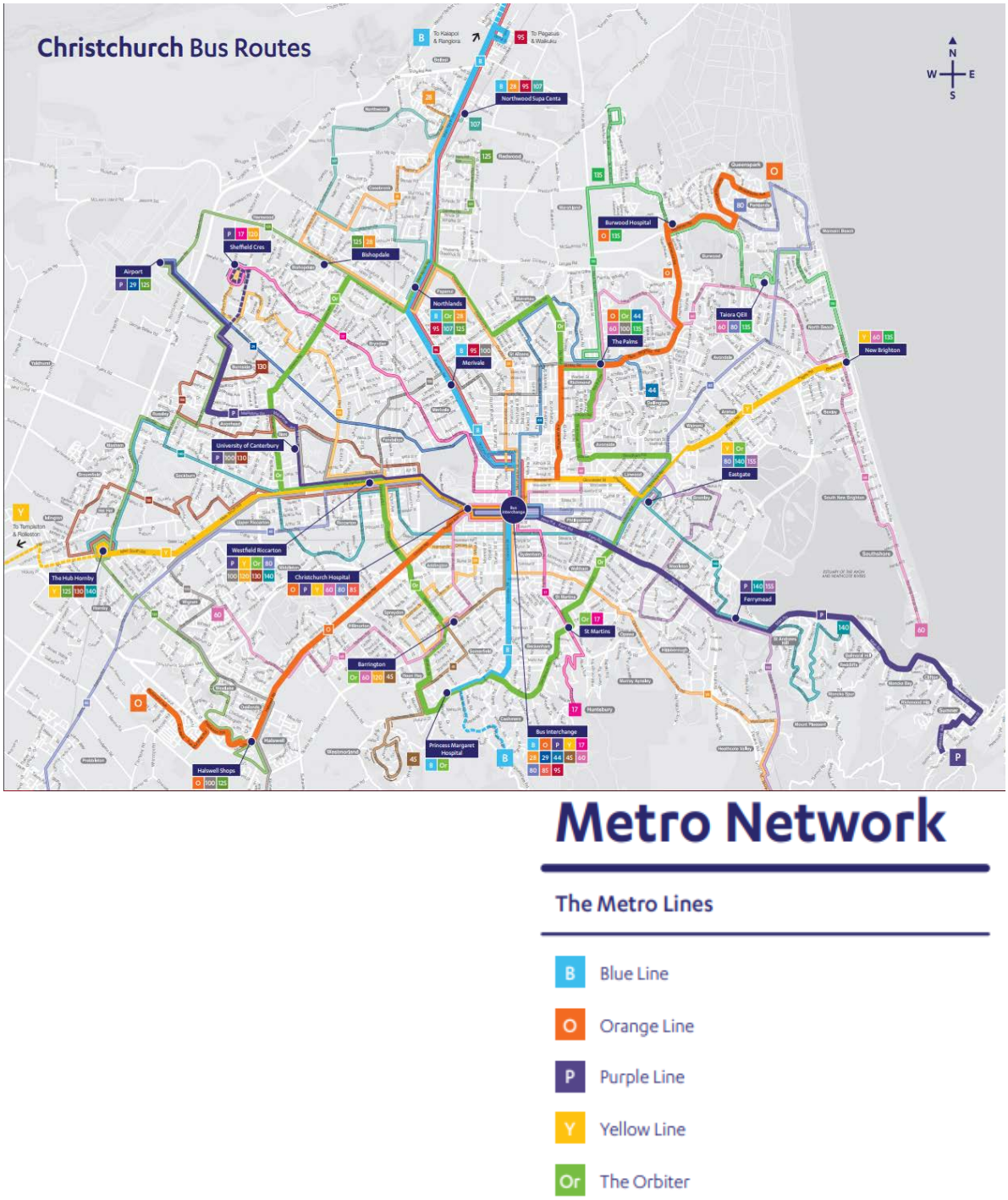

Figure 1 Christchurch Bus Network and Routes (top) and the five core metro routes and colours (left). Source: Metro Info 2018

Table 1: *Existing Core Routes* in *Christchurch*

The existing core routes are:	
The Orbiter	Bi-directional circular route linking suburban malls, schools and attractors.
Orange Line	Halswell to Queenspark (and return) via Addington, Christchurch Hospital, the central city, The Palms and Burwood Hospital.
Yellow Line	Hornby to New Brighton (and return) via Bush Inn, Riccarton, Christchurch Hospital, the central city and Eastgate.
Purple Line	Sumner to Avonhead (and return) via Ferrymead/Woolston, the central city, Christchurch Hospital, Riccarton, the University of Canterbury and Christchurch International Airport.
Blue Line	Belfast to Barrington (and return) via Northlands, Merivale, the central city and Sydenham.

Table 1 Source: Canterbury Regional Public Transport Plan of 2018 – 2028, (ECAN 2018, pg. 20)

At first glance, PT seems the ideal solution to the problems of private car usage. Wright and Fulton (2005) found that emissions per passenger kilometre from PT is far less when compared to private cars. In major New Zealand cities, the average private vehicle occupancy stands at 1.54 whereas buses can take up to 60 passengers at peak usage (Transport and Industrial Relations Committee, 2017). According to the Transport and Industrial Relations Committee (2017), this should allow each bus at peak times to move as many people as 40 cars while a single bus will take the road space of about three cars. This makes PT considerably more environment-friendly compared to private cars and would drastically help lower greenhouse gas emissions.

Notwithstanding these advantages of PT, PT usage is limited, sitting at around 2.5% of peak hour travel demand in Greater Christchurch (ECAN, 2018). Bus patronage levels in Christchurch has fallen by 12% over the last 10 years (ECAN, 2018), especially after the 2010 and 2011 earthquakes. Over the last few years, Christchurch's bus service recorded 13.36 million passengers. Currently, around 13.5 million boarding passenger trips are registered per year in Christchurch for bus only, which is below pre-earthquake levels of 17.2 million per year in 2010 (ECAN, 2018).

The "Canterbury Regional PT Plan of 2018 – 2028" (ECAN, 2018) for Christchurch identifies several issues in the current PT systems

1. Current PT systems are mostly unreliable and journey times are greater when compared with private car times.
2. Current PT systems are not always adequately integrated with existing and planned land use in Greater Christchurch.

3. A poor perception exists in Greater Christchurch about using PT.
4. The high amount of emissions emitted from the current PT systems which are harmful to the environment.

The Morgan Foundation (2016), as cited in New Zealand Productivity Commission (2018), states that sprawling and low-density development makes people travel further which makes PT systems either unavailable or not cost effective. Christchurch comprises mostly medium to low-density areas (Nunns, and MRCagney Pty Ltd, 2014), and Greater Christchurch is lower density (ECAN, 2018). ECAN (2018) states that a poor perception about using PT exists in Greater Christchurch. One of the main issues reported by potential PT users is that PT service is not frequent enough which causes inconvenience. Further, the lower density of Greater Christchurch means that there are fewer people within walking distance of PT stations. Saroli (2015) states that private vehicles may be more convenient for locals in rural or far away areas because PT services are limited in such places and are less accessible.

After the 2010 and 2011 earthquakes, PT investment in Christchurch has been minimised with the focus being around repairing road infrastructure. The New Zealand Transport Agency (NZTA) (2019) state that $137 million will be invested in PT over 2015-18. But a total of $489 million is being reserved for the maintenance, operation and renewal of roads within Greater Christchurch throughout that same time. Additionally, another $841 million investment is also expected for new roads and network improvements (NZTA, 2019). For Christchurch central city, an accessible city 30 year program have been set up to allow individuals and business to move back into the city (NZTA, 2019). The idea is to provide a safer and convenient means of transport by creating a pedestrian-friendly and cycling friendly infrastructure to support the inner city and the surrounding PT network. This is expected to take a total of five phases over the 30 years and so far $18 million has been co-invested by the transport agency (NZTA, 2019).

3.0 Shared Mobility

If the current PT system is not properly meeting the needs of the population, it is necessary to either improve the current system or introduce alternative systems which complement the current system. An alternative is shared mobility. In this section, I

introduce the idea of shared mobility and describe four examples of shared mobility in Christchurch.

Shared mobility can be defined as a network of systems which allow users to have short-term access to various forms of transport on a need-to basis (Shaheen, 2015). Shared mobility are on-demand vehicles which allow road users to share modes of transport from one destination to another. (Laporte, Meunier & Wolfler Calvo 2015; Machado, de Salles Hue, Berssaneti & Quintanilha 2018). The fact that multiple road users share a means of transport makes shared mobility one potential solution to reducing private vehicle numbers in Christchurch.

Figure 2 provides an overview of the various shared mobility systems and their different services. The four main systems in Christchurch are:

1. Bike Share
2. Car Share
3. Ride Share
4. Ridesourcing/Ride-Hailing or Ride-Splitting

Due to the fast-changing nature of the shared mobility market, new systems are appearing every few months. However, I will focus on the four case studies above.

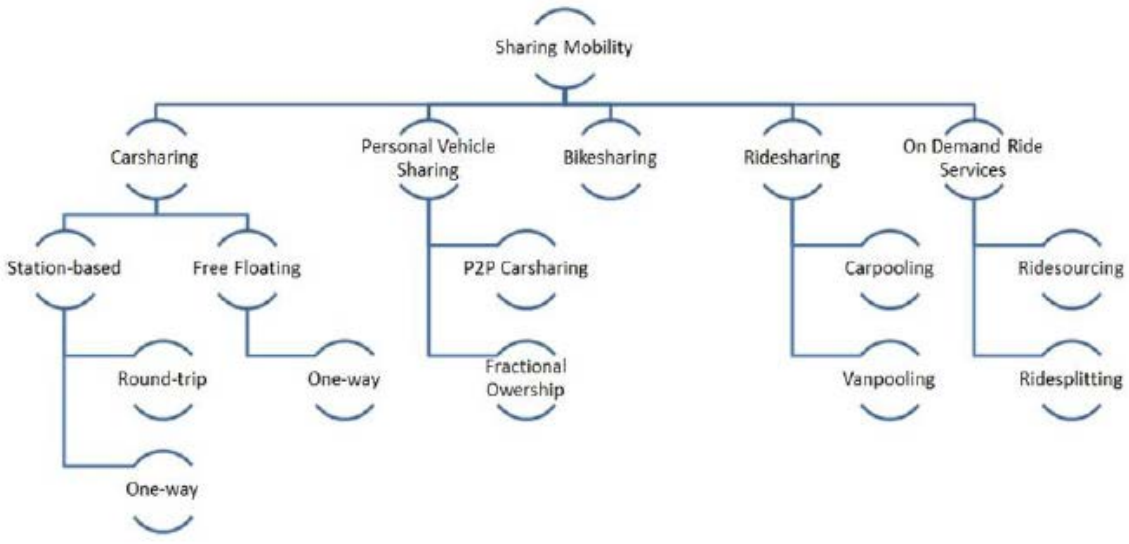

Figure 2: Different Shared Mobility systems (top). Source: (Machado, de Salles Hue, Berssaneti & Quintanilha, 2018, pg.6)

Bike-Share allows users to rent a bike on an hourly or daily fashion for a fee. Bike-Share systems generally use dock-based stations that are distributed throughout the

service area for users to use and return to a station (SUMC, 2015). In Christchurch, bike share sign-up costs stand at $4, which is followed by a period of no cost for the first 30 minutes. After that, it is $4 per hour but if a user rides for more than 5 hours, a daily fee of $20 is the maximum ("Prices", 2019). No information could be found about the annual usage rate of bike share in Christchurch as the system trial has ended in Christchurch. Other new forms of bike sharing system are now being used. These are "dockless or GPS" based systems. They allow users to lock their bikes after usage within the service area without having to return it to any docking station (SUMC, 2015, pg. 4). Research from Shaheen and Chan (2016) and Kaufman, Gordon-Koven, Levenson & Moss (2015) found that bike sharing helped improve PT usage.

Car-Share is similar to bike-share as it allows users to access vehicles on an hourly basis with an extra cost per kilometres until the mileage is capped (SUMC, 2015). Car-Share is different from traditional forms of car rentals as the upfront paperwork to sign up is removed; car sharing is all app based. Further, there is no requirement to go to a car rental hub to meet and pick up the keys. Car-Share users can register through an online app. The two most used forms of car sharing are the conventional form of car sharing, which is known as "round-trip" that allows users to borrow the vehicle but it is also expected that they return the vehicle at the same location. The other is "point-to-point" which requires users to pick up the vehicle at one spot and return it to another (SUMC, 2015, pg. 5-6).

In Christchurch, an example of car sharing is Yoogo Share. This is an electrical car sharing service. There are seven locations in Christchurch where these cars exist. A mixture of electrical BMW i3s and Hyundai IONIQs cars are available in these locations. There is overall a fleet of at least 100 electrical cars in Christchurch ("Yoogo Share | Smart Electric Car Sharing", n.d.). The cost for these in Christchurch is $0.46 per minute and $14.50 per hour. There is also variation in price for certain times of the day, overnight and weekend use. The system is currently free to join with no membership cost ("Yoogo Share | Smart Electric Car Sharing", n.d.). Once again no usage data was available for this service.

Ride-Share allows users to add passengers to their pre-existing trips (SUMC, 2015). There are a few different types of ride sharing systems but the most used are carpooling, vanpooling and real-time dynamic ridesharing. Carpooling allows users to

ride together to save fuel and operating cost. Vanpooling generally is run by public transit systems, it allows a group of users to travel together, and is often aimed at co-workers. Vanpooling has more users than carpooling (SUMC, 2015). Christchurch has service providers who provide ride sharing services on the side, such as Green Cab and Airport Shuttle and Uber. However, there are no service providers in Christchurch who provide purely ride sharing. SAVY, which operates in Queenstown is the nearest "pure" ride sharing service for Christchurch. SAVY is an app-based on-demand service where the ride is pooled for economic travel ("Savy", 2019). The pickup and drop of zones are informed to the user when to make a booking. The cost of the system is $1.70 per km with a minimum of $7 in most of the main zones in Queenstown. SAVY service has now ended in Queenstown which means that there is no available data on its usage rates ("Savy", 2019).

The fourth example of shared mobility in Christchurch is Ridesourcing/Ride-Hailing or Ride-Splitting. These are systems which allow their users to connect with their drivers through an online app and the drivers generally use a private vehicle (SUMC, 2015). There is a sense of controversy surrounding ridesourcing and hailing as it is not a form of shared transport however it has been known to reduce private vehicle ownership. However, ride-splitting is a form of shared mobility, as passengers split the cost between each other or with other riders on the same route. The cars also not owned by the passenger so it differs from carpooling where cost is saved for the user who rented the vehicle (SUMC, 2015). An example of a ridesourcing company in Christchurch is Uber. Uber has since evolved many services which cross over with ride-sharing but in general Uber is ridesourcing as users have to connect with their drivers through the online app for a private vehicle. The current fare for Uber in Christchurch is $1.75 per booking with $0.40 per minute, $1.45 per km and service fare of $0.55 ("Uber Christchurch - Price Models & Historical Rates", n.d.). Research from Carranza et al., (2016) states that ridesourcing systems allow users to save costs on purchasing, operating and maintaining private vehicles, which should lower private car ownership and car congestion.

1.4 Research Value

Studies on the feasibility of shared mobility generally focus on medium-to-high density cities such as Auckland. There is limited work on shared mobility in medium-to-low density cities and no work in at all on shared mobility in Christchurch. The above

discussion identifies that there is scope for shared mobility to help support PT in Christchurch. The poor usage of PT in Christchurch provides an opportunity to develop a model of shared mobility that supports PT and reduces private vehicle usage. Such studies need to happen before population growth puts pressure on existing infrastructure and force public authorities and private users to adopt “reactionary” solutions which are usually less well thought out and difficult to integrate. My study is case-specific but other low-to-medium density cities in New Zealand and elsewhere could benefit from the findings.

1.4.1 Research Question and Aims

My research examines what factors are influencing low PT usage in Christchurch and how might shared mobility systems support PT in Christchurch?

My aim is to:

1. Identify what is affecting low PT usage and what might change in the future in Christchurch.
2. Identify the perceptions toward shared mobility and discuss the potential of shared mobility in supporting PT.

In order to achieve my aims, my methods include:

1. Interviews with local policymakers to understand their perspective on what is affecting low PT usage in Christchurch and what may change in the future.
2. Interviews with local shared mobility operators to understand the potential of the shared mobility systems.
3. An online survey to understand the current transport usage patterns in Christchurch from the perspective of the local community and identify their perceptions towards shared mobility.

1.5 Structure of the Thesis

I have introduced the research topic in Chapter One. Chapter Two will focus on the literature review. Chapter Three will focus on the methodology. Chapter Four will present the primary data results from the interviews and online survey. Chapter Five will present the discussion and analysis of the primary data and its implications for the research. Chapter Six will comprise a conclusion.

Chapter 2: Literature Review

2.1 Introduction and Structure

My research question is what factors are influencing low public transport (**PT**) usage in Christchurch and how might shared mobility systems support PT in Christchurch? In order to achieve this the first section of my literature review will look at existing literature on the importance of PT and evaluate what factors lead to PT systems operating well or underperforming. I will then review the research in the field of shared mobility and look to identify what is being discussed as the potential for the system.

2.2 Importance of PT

PT refers to systems of different vehicles (e.g. buses, trains, trams, boats, ferries and many others), which are available for the general public to use on a daily basis. New literature is also now adding shared transport, park and ride and demand responsive transport to the definition under PT (Ministry of Transport, n.d.).

There is some debate regarding whether public funding is a requirement for transport to be defined as PT. Interestingly even the Ministry of Transport (n.d.) state that lines between “public”, “private” and “shared” transport is getting blurry with everyday technology improvements (n.d. pg. 11). While some argue that PT has to be publicly funded, the rise of privately funded transport also falls in the same category and plays a critical role in the movement of people. Whether the PT services are public or private governments help subsidize the systems in many places around the world as PT systems alone cannot sustain their running costs (Schofer, 2019).

There is considerable literature on the importance of PT in cities worldwide. International Association of Public Transport (2017) (**UITP Study**) revealed that in 2015, 243 billion PT journeys have been made across 39 countries worldwide. The UITP study includes data from 27 European countries 12 other countries such as the United States of America, Canada, China, Australia, New Zealand and Russia. The UITP study found that 27 out of the 39 countries showed an improved or stable PT usage over the past 15 years. This hints at the growing nature of PT and its importance for daily commuting.

However, it should be noted that some of the data of the UTIP study may not have been reliable as there were issues with access to some of the countries studied. Further, it is important to keep in mind that each country is different and has different population demands and socioeconomic conditions. The reasons why other countries studied showed stable or increasing usage of PT may therefore not apply to New Zealand.

Efficient PT services are integral to a smooth-flowing transport network. As of 2009, more than half the world's population live in urban areas (United Nations, 2014). This number is expected to grow and reach close to 70% by 2050. This means that the importance of PT is likely to rise due to growing populations. This means demand for mobility will increase and if PT infrastructure cannot meet future demands there will be increases in waiting times. This could in turn increase car dependency, resulting in increased congestion (Samek Lodovici and Torchio, 2015).

PT is also essential for people with limited ability to use other forms of transport due to physical or mental disabilities (iTRANS Consulting Inc, 2008). This is because people with disabilities are often unable to transport themselves by driving cars or biking. Without PT, they would be reliant on family and friends to transport them.

Areas with strong functioning PT systems thrive economically as it creates a network of activities around different locations, which attracts new visitors (Hazledine, Donovan and Bolland, 2013). Rodrigue, Comtois and Slack (2017) state efficient and connected PT systems provide opportunities for economic and social benefits as they allow better accessibility of markets which increases employment.

PT is perceived to be more environmentally friendly than private car dependency. This is backed up by the US Department of Transportation (2002) who state that PT in such cities help create a safe and healthy environment, because it lowers private car ownership leading to less road congestion, lowers accidents, saves money, reduces air pollution and reduces oil and energy consumption.

2.3 Factors that cause PT to operate well

The foremost objective for most city planners and policymakers is to build a PT system that supports their local population, however, this is not always achieved everywhere. Many studies around the world have sought to understand the key determinants for

attracting people to PT. Research in this field includes the studies of Buehler (2011), Currie, Ahem and Delbosc (2011) and Loo, Chen and Chan (2010). In this section, I will look at how some indicators can be used to understand why PT systems succeed or fail in different regions around the world.

2.3.1 Measures of PT effectiveness

Anderson, Condry, Findlay, Brage-Ardao & Li (2013) state that key performance indicators (KPI) are used by PT operators to determine how well their systems are running for their user. Some of these KPI indicators are how many passengers are affected by delays (time), stock available for service (availability), the number of times passengers exceed above the capacity of stations and peak services available at that time (frequency). Anderson et al further state that without proper KPI information operators, policymakers and other transport authorities struggle to understand the convenience for the customer base.

However, the use of KPIs as the sole indicator of effectiveness is debatable. ITF and OCED (2014) highlight that while KPI indicators are a great tool, they are limiting in the sense that they do not capture external factors. They highlight that the availability of PT in rural areas can be a major factor. Cooke and Behrens (2016) state that population density affects PT's viability.

The literature highlights that other factors can exist alongside KPIs to assess the effectiveness of PT. I have therefore used KPI and non-KPI factors when considering what factors affect PT in Christchurch. The factors I have used include population density, accessibility, the perception of PT, cost and economic feasibility are also greater indicators to understand PT systems.

2.3.2 Population Density

High population density is correlated to more effective PT systems. Research has found that cities which encourage urban lifestyles tend to attract more users and investors to PT (Denne and Wright, 2016). Urban lifestyles are associated with very developed regions with high population density, which are surrounded by buildings, roads, houses, bridges and skyscrapers where many people live and work. Examples are downtown Sydney or Manhattan and New York City (Ghel, 2010). PT in these cities plays a major role in transport as it assists with the daily commuting to work and elsewhere. A study by Choi, Lee, Kim and Son (2012) in Korea found that high density

built environments help attract users to PT especially after office hours. PT usage helps to lower the pressure of private car ownership and allows cities to be sustainable for the future. Planners believe that “increasing density” with the appropriate provision and improved infrastructure of PT leads to less private cars (Pund, 2001). This is also stated in the “Canterbury Regional Public Transport Plan of 2018 – 2028” which states that PT performs better in a compact urban environment where the number of potential passengers live and work in close proximity of PT systems (ECAN, 2018). This encourages direct and high-frequency PT services that connect commercial, retail and recreational activity sites more easily (ECAN, 2018).

In medium-to-lower density cities, especially in New Zealand, PT generally tends to have lower patronage and it is not cost-effective to provide PT services in certain areas. The “Canterbury Regional Public Transport Plan of 2018 – 2028” report highlights that areas with low populations and low-density regions are avoided by service providers because of cost-ineffectiveness. Research also found that suburban sprawl in medium to low-density cities affects the quality of service and convenience of using PT (Church, Frost & Sullivan, 2000). Studies by Gray, Farrington, Shaw, Martin and Roberts (2001) in rural Scotland and by McDonagh (2006) in rural parts of the Republic of Ireland found car dependency higher in such areas compared to other forms of transport. Further, a study by Borg and Ihlström (2019) in rural Sweden in low-density areas like Östergötland, Dalarna and Jämtland h found car usage was far more preferred when compared to PT or ride-sharing because of the flexibility accorded by cars. However, a limitation of the Borg et al. study is that only 17 respondents were interviewed: a bigger sample size would have allowed a better reflection of these rural areas.

PT service providers find it more difficult to meet the needs of residents in medium-to-low density areas. Often, the spatial distance between individual residents or between residents and the central city means that it is not financially viable to provide PT services such as bus stops in convenient proximity of residents or at times that meet their individual needs (Church, Frost & Sullivan, 2000). Many studies have found that cars provide greater flexibility to residents in medium-to-low density areas: see Denne and Wright (2016); Brake and Nelson (2007); Velaga, Beecroft, Nelson, Corsar & Edwards (2012).

However, medium-to-low density populations do not always hamper PT usage. In Japan, PT in the form of railway services has been more successful in meeting public demands in low-density areas. Railway PT systems have been subsidized by the government in Japan through semi-public companies (Kurosaki, 2018). Ideas for a railway service for Christchurch residents have been proposed but a lack of funding from the Government makes this unlikely to take place (Johansen, 2019).

Several researchers have suggested ways to improve transport services in medium-to-low density areas. Brake and Nelson (2007) ask for a more integrated transport system for their case study in Northumberland where PT is supported by other forms of transport. Velaga et al., (2012) state more flexible on-demand transport systems for rural areas can be a solution. This is also supported by Daniels & Mulley (2012) who claim that flexible transport services in low urban density environments are valuable options to consider when compared to schedule PT service, which is limited. The recommendation for flexible on-demand services suggests there is a scope for shared mobility to support PT in medium-to-low density areas.

2.3.3 Accessibility

For every metropolitan area of the world, efficient transport accessibility is always the main goal for policymakers according to Saghapour, Moridpour and Thompson (2016). Accessibility is connected with population density. Betanzo (2007) finds that higher population densities have better accessibility to PT because there are more people walking and cycling and fewer people using private cars, which opens up more space for the provision of PT and makes PT more accessible. Saroli (2015), claims that in low population density areas in rural France poor access to PT services makes journey times longer. Low population density means walking distances to bus stops are greater and this resulted in higher car usage in rural Sweden (Borg and Ihlström, 2019). An exception to this general correlation is Riga City. Riga City is densely populated but had major accessibility issues for both PT and car (Jackiva et al. 2017).

More walking is connected with greater PT usage possibly because of a willingness to walk increases accessibility to PT. Research from the Ministry of Transport (2015) found that in New Zealand, using PT frequently led to more walking on a given day.

2.3.4 Frequency/Availability and Time

ITF and OECD (2014) state that Korea, usage policy has been implemented to improve overall convenience for PT users. Such policy aims to reduce travel times and waiting times by offering more frequency of services. Although the direct impact from the policy change is unknown theoretically PT usage should become more convenient for the user in Korea.

Taylor and Fink (2013) found that high levels of service coverage improved accessibility for PT and while improved frequency service also resulted in lower travel times.

Stradling, Meadows & Beatty (2000) found that in the UK, quality of service was the most influencing factor for drawing people into PT. Better quality included shorter times, shorter interchange time and greater reliability. A Christchurch study by the Christchurch City Council (**CCC**) (2017) found that among people who did not use PT over the last 12 months, 51% of respondents requested that they wanted more direct routes while 36% wanted a better frequency of services. Improving convenience and frequency would encourage them to use PT more often.

Mees (2000) and Yencken (1996) stated that the successful nature of PT systems in Toronto and Zurich is down to the integrated structure of the network. The rail systems in Toronto and Zurich are appreciated because of their frequency of service and reliability.

2.3.5 Perception of PT

Literature suggests that poor perception PT reflects more fundamental underlying issues with PT service. Imran, Yin and Pearce (2015) looked into the experience of Asian migrants of Auckland's PT found that affordability, reliability and low frequency played a role in the poor perception of PT. Other factors were poor customer service and language barriers.

A study in Bathinda City, Punjab, India from Gaurav, Amandeep and Kiran (2014), found locals to be happy about PT when PT was generally delivering good network service, security, comfort and cleanliness. By contrast, middle and lower income group members agreed that two reasons which made them perceive PT negatively were overcrowding and the travel duration.

This suggests that improving PT services should result in improved perception, which would, in turn, encourage greater use of PT. Mat et al. (2018) found in a study in Kuala Lumpur that improvement in quality and efficiency can help attract users to PT. (Jackiva), (Budiloviča) and Gromule (2017) argue that attractiveness of PT could improve with more door to door services.

2.3.6 Cost of PT

Shergold and Parkhurst (2012) and Smith, Hirsch and Davis (2012) state that PT service for rural areas can be challenging due to the cost of fares to customers. A CCC (2017) study of 4500 people who did not use PT over the last 12 months found that 29% asked for a reduction in fares to encourage them to travel by PT.

In New Zealand, PT is poorly subsidized in many places. The Government only subsides half of the cost for the PT systems through the National Land Transport Fund. Most of the PT services in New Zealand have private sector contracts which run under the local council and the other half is aimed to be recovered by fares ("Land Transport Management Act 2003 | Ministry of Transport", 2018). In contrast, Kurosaki, (2018) pointed out that in Japanese railway PT systems are well subsided by the government in Japan through semi-public companies. This is also backed up by Buehler and Pucher (2011), who state that in Germany most local transit providers are well subsidised. Financially both these countries have strong backing from their governments to run their PT services and both places have enough medium to low-density cities which use the PT system well. In Luxembourg, all PT fares have been slashed for free service. Ticket revenues do not even account for 3% of the cost to run PT in Luxembourg. The Luxembourg Government's plan is to move people away from other forms of transport by removing the barrier of fees (Calder, 2018).

However, Bunting (2004) claims that low fares for PT could actually be harmful to the long run for the PT service. He states that while cutting cost for PT may attract a handful of new customers the offset is not big enough to generate major revenues. Bunting also believes that no matter what subsidies are offered some people will never consider a bus service. An example is a businessman on a tight schedule.

2.4 Potential of Shared Mobility

In this section, I look into the potential for different shared mobility systems to support PT by reviewing the positives and negatives of such systems. I will first briefly address what shared mobility is before considering the different systems.

Shared mobility allows users to gain short-term access to different modes of transport to get from one place to another on a need to basis (Shaheen, Chan, Bansal and Cohen, 2015). It includes several systems such as:

- Bike-Share
- E-Scooter Share
- Car-Share
- Ride-Share
- Ridesourcing/Ride-Hailing or Ride-Splitting
- Community Shared Transport

The defining feature of shared mobility is shared use. Rather than an individual owning, buying and controlling a car, a bike, or scooter these physical assets are accessible for use to everyone through a fixed pay per use rate (Vine and Polak, 2015). This causes some to question whether certain forms of transport count as “shared mobility” (Cohen and Shaheen, 2016; Shaheen, Cohen and Zohdy 2016). Eckhardt and Bardhi (2015) state that car sharing should not be considered under the shared mobility term because only one user rents a car at a time. However, a counterargument would be that car sharing is still shared mobility because the same car is used by different people instead of being owned by one person or family for their continuous usage. I have treated car sharing as a form of shared mobility in my study.

Shared mobility, in theory, has the potential to support PT. Research from Laporte, Meunier & Wolfler Calvo (2015) and SUMC (2015) discusses the “rising popularity” of shared mobility and the potential of these systems if certain challenges can be overcome. Laporte et al. (2015) and SUMC contended that shared mobility can help lower CO_2 emissions, lower traffic congestion, improve accessibility, improve wellbeing, lower cost for services, increase the use of PT, increase employment, solve the first and last mile issue, lessen car dependency and increase efficiency and convenience of transport for users. Not only do shared mobility systems thrive in high-

density urban environments they also known to attract patronage in many medium to low-density or suburban areas (Cohen and Shaheen, 2016). However, it should be noted that shared mobility usage varies from place to place depending on the local population and currently there has been a limited amount of work which has looked into how these systems are used in smaller cities (Shiftan & Kamargianni, 2018).

Integrating shared mobility with other systems of transport is potentially a challenge (Cohen and Shaheen, 2016). Raubal et al. (2017) claim that shared mobility systems are secluded systems which often do not consider working with other transport modes. This can limit shared mobility's ability to support PT.

However, a potential solution to the integration problem is the use of app-based on-demand systems. Using apps to access shared mobility is becoming increasingly common. Connecting through apps can help improve customer efficiency and also allow many transport options to be displayed (Transport and Industrial Relations Committee, 2017). Ohnemus and Perl (2016) state that combining shared mobility apps with future on-demand mobility options could help low-density cities where private car usage has been important. This is possible because of the greater flexibility that on-demand app-based usage offers to individuals who find that PT does not respond to their specific transport needs. Meng, Somenahalli, Allan and Berry (2018) state that shared mobility could play a critical role in Mobility as a Service (MaaS) especially as bike-share and car-share already play a part in first and last mile solutions.

Some researchers consider autonomous vehicles to have the potential to improve shared mobility services. Autonomous vehicles have the potential to reduce privacy and safety concerns about sharing vehicles with unknown drivers. They can also eliminate human factors that affect services such as illness or another incapacity. Cohen and Shaheen (2016) state that shared mobility will likely adjust in the future and have some sort of autonomous vehicle presence; in fact, the current transformation into autonomous vehicles is already happening for some urban environments. Ohnemus and Perl (2016) state that Shared Autonomous Vehicles (SAV's) are a likely possibility in the near future.

2.5 Types of shared mobility

This section looks at various shared mobility systems around the world. The section first highlights the usage, then the positives and negatives found in academic research.

2.5.1 Bike Share

China is running one of the biggest and most popular bike-sharing schemes. Since the launch of the system in 2008 the public bike-share system (PBS) has been adopted across 61 cities as of 2013 with a bike fleet of over 600,000 bikes (Lohry & Yiu, 2015). Hangzhou holds the biggest bike-sharing market in the world with a bike fleet of 69,750 and 2,762 stations spread over 300km. Further, it generates close to 240,000 trips on an average day from daily users (Lohry & Yiu, 2015). Berger (2018) states that consumers find bike sharing easy to use and a low-cost option in China when compared to other modes of transport.

Other popular programs like Velib in Paris, has a daily ridership average between 50,000 to 150,000 people and a fleet of 20,000 bikes (Erlanger & Baume, 2009). Santander Cycles in London and Citi Bikes in New York City all boast impressive numbers with fleets of over 11,500 and 6,000 bikes respectively, which are used daily (Transport for London, 2018).

Research from the American Public Health Association found numerous social benefits related to bike share programs. This included a reduction in stress levels and weight loss (Caulfield et al., 2017). The study from Alberts, Palumbo and Pierce (2012) into the Capital Bike-share program from Washington showed that out of the 2,830 respondents, 21% rated exercise and recreation as their main reasons to use the program. Further, 31.5% of the users stated that the program had reduced stress and 26.7% stated that their stamina had increased due to the program. Another 30% of respondents also claimed to have lost weight thanks to the program (Palumbo and Pierce, 2012). Ricci (2015) states that collectively enough studies have been conducted to suggest that bike sharing does have health benefits. Ricci states that a survey of active users in the current London BCH (Barclays Cycle Hire) schemes stated that the main reasons for using bike-share were health/fitness, speed and convenience.

Shaheen and Chan (2016) state that they believe bike sharing can help improve PT usage and can be an effective way of solving the first and last mile connections. Dowling (2018) states that individuals can ride short distances quickly using bike share. Their use can help users bridge the gap between home and transit or transit and work location. Parkes, Marsden, Shaheen and Cohen (2013) gives examples of integrated PT and bike share systems can be found in places like Antwerp, Dublin, Cardiff and San Francisco. Lesh (2013) also believes that an integrated PT system with shared transport systems could help solve the first and last mile issue. A study by Kaufman, Gordon-Koven, Levenson & Moss (2015) on the Citi bike program for New York City found that 75% of bike sharing station location was within a five-minute walking radius from a subway station. This allowed a connection to PT services which should theoretically improve first and last mile connections.

However, this theory may vary by cities as Campbell, Cherry, Ryerson and Yang (2016) found that e-bike sharing was possibly a contender against PT because bad weather, longer trip distances or poor air quality did not have a major effect on their usage patterns. This meant the authors failed to conclusively claim that bike sharing was actually helping first and last mile connections. Further, Shaheen, Zhang, Martin & Guzman (2011) studied 800 customers in Hangzhou and found mixed results about the interaction between PT and bike share. They found bike sharing was a competitor to PT and yet complemented PT at the same time.

Low public awareness of bike share is a potential barrier to its success. Circella, Alemi, Tiedeman, Hand & Mokhtarian (2018) conducted a survey in California and found that most respondents had never used bike sharing and only a few had heard of the service. The 58% of the respondent from that survey also stated that they were not sure if bike sharing was available for use in their area.

The risk of vandalism of bikes is another disadvantage. The experience of bike sharing in Dallas, USA highlights this. Many bikes were either vandalised or thrown abroad into the river (Linderman, 2018).

Effective management and decision-making by operators can be critical to the success of bike sharing. In Dallas, USA, the failure of the schemes was attributed to poor management of the bike-share operators. Even before the system was put in place, only 0.2% of Dallas local population used cycles for daily commuting (League of

American Bicyclists, 2015). This meant that when near 20,000 new bikes entered into the region they were left unused. The city also has a lot of sprawling regions as most people generally drive to the city centre for work (Linderman, 2018). Therefore, bike sharing may not be suitable for every city.

2.5.2 Car Share

As of 2014 in the United States, more than 1.34 million people use car sharing (SUMC, 2015). In Seattle, car2go has more than 59,000 members in the city alone. As of 2016, car2go has expanded to 32 cities around the world due to its demand and now has been deemed as the largest car-sharing program of the world (Kortum, Schönduwe, Stolte & Bock, 2016).

Other major car-sharing schemes include ZipCar, which runs in the United States and has over 350,000 members (Patel 2009 and SUMC, 2015). In Germany car2go and DriveNow have over 850,000 and 720,000 customers respectively on a yearly basis. Further, as of 2018, at least 2.1 million registered members of car sharing service can be found across Germany (Reyes, nd).

An example of the success of car share in a low densely populated can be found in Trento, Italy. A car-sharing scheme has been set up to allow alternative use to private cars. Across the Trento, Rovereto, Riva del Garda and Levico area around 15 car-sharing vehicles are available for 178,000 inhabitants. Since the initial launch in 2009, over 3000 trips have been made and at least over 400 users are using it on a weekly basis (Rotaris & Danielis, 2018). Rotaris and Danielis believe that the small car sharing scheme worked due to the cheaper cost. It is more convenient for local users when compared to other transport options.

I have noted before that criticism of car share is that it is arguably not “shared mobility” because usually, only one person uses the car at a time (Eckhardt and Bardhi, 2015). This could create the impression that car sharing does not help reduce congestion or pollution unlike other forms of shared mobility like bike share or ride sourcing.

However, studies show evidence that car sharing can actually reduce car ownership. Giesel and Nobis (2016) note that a free-floating car share scheme has been immensely popular in Berlin and Munich, Germany. The new low emission, low energy consumption and electric vehicles have lowered the usage of private cars and improved the amount of CO_2 emissions released.

Giesel and Nobis (2016) surveyed two car-sharing programmes, DriveNow and Flinkster, in Berlin and Munich, Germany. The results showed that 72% of the interviewed Flinkster users and 43% of the DriveNow users lived in a household which had no private cars. The reason for such a big number without private car ownership was down to some important factors, which included “costs”, “car sharing is sufficient”, “environmental protection” and others.

Research from City CarShare stated that a study was done by U.C Berkeley in Philadelphia and Chicago highlighted that between 24% and 29% of respondents had sold a car after using car share (City CarShare, 2011). Another study by Schaefers, Lawson and Kukar-Kinney (2015), in the United States, found that users who used rental cars had a higher chance of reducing car ownership. However, this did not mean that the user gave up car ownership but just usage was reduced.

Other factors also make car share appealing. Yakovlev and Otto (2018) found car sharing users to express ease of use, convenience and no need to purchase vehicles as the key reason behind using car sharing. Drápela, (2015) found price, accessibility and level of services to be a critical factor which influences users to use car sharing service. Ballús-Armet, Shaheen, Clonts and Weinzimmer (2014) found that peer-to-peer car sharing was popular amongst 300 surveyed people from San Francisco and Oakland because they were convenient and available for use, financially viable and expanded their transport choices.

Car share can supplement PT. Firnkorn and Müller (2011) found that car sharing in Ulm, Germany, often led to improved PT usage, while Le Vine, Lee-Gosselin, Sivakumar & Polak (2014) found that in London one-way car-sharing is often used by places surrounding PT.

Lack of public awareness is a weakness of car sharing. A research study by Circella et al. (2018) of 1967 respondents from different California counties found that a majority reported that they had heard of car sharing but had never used the systems. One explanation of this could be the availability of car share. Interestingly Circella et al. (2018) claim that in California, respondents also perceived the availability of car sharing to be lower from most areas except, San Francisco Bay Area. Further, the majority of users reported being not sure if the service was available for use. Moreover, in the Czech Republic, similar results were found about car sharing usage (Drápela,

2015). As the majority of respondents had never heard of the system and only a small number of respondents knew how to use car sharing.

There have also been instances were schemes of car sharing has failed. In Berlin, a car-sharing program has failed due to the inability to attract users. The emov vehicles from the PSA group provide a 200 free floating car fleet in Berlin; however, issues included users having to walk more than a kilometre to find a usable car, limited amounts of car available for the city and poor software. These led to a total failure of the shared mobility program (Sigal, 2017). This failure also portrayed the importance of having a system which is user-friendly for local users to allow them to consider the option as an alternative especially in a city where PT is well used.

2.5.3 Ride Share and Ridesourcing/Ride-Hailing or Ride-Splitting

This section looks at ride share and ride-sourcing/hailing and splitting. Ride share is conceptually different from ridesourcing/hailing or splitting, as discussed in the Introduction in Chapter 1. However, I have combined the literature review for these systems because various researches have highlighted the similarities between ride-sharing and ride-sourcing/hailing and splitting (Rayle, Dai, Chan, Cervero & Shaheen, 2016). Further, the same operators sometimes run both ridesharing and ridesourcing/hailing or splitting systems, which can sometimes lead to these companies being cited as examples of ride share and at other times as examples of ridesourcing/hailing or splitting.

One of the biggest operators of rideshare, ridesourcing/hailing or splitting is Uber. Uber service is available in over 83 countries and 647 cities worldwide. As of 2016, Uber had a total of 2 billion rides (Business of Apps, 2017). A study by Pew Research in 2016 stated that 15% of Americans had used ride-haling services by using the apps (Smith, 2016). It is a lot more popular when compared to traditional car-sharing services. Lyft meanwhile had 163 million booked rides in 2016 which were far fewer when compared to Uber.

Ride-sharing has many benefits. Ride-share helps bridge the gap between distant or underdeveloped areas with poor PT and the developed central city with effective PT by allowing customers to connect to PT. For example, in Auckland, 43% of trips help connect users to different transport hubs which helps solve the first-mile issue (Uber, n.d).

Rideshare can also reduce the opportunity for violence or dangerous driving. Since the launch of uberX in Sydney, uberX has been used for over 450,000 trips out of the Sydney alcohol lockout zone especially in the early morning hours, which is expected to have reduced any violent and disorderly behaviour (Uber, n.d). Uber's four-minute response time is credited for its success because the on-demand service is so quick that intoxicated users do not have to wait in transport hubs for too long or risk driving home with conditions unfit for driving.

Uber's four-minute response time also makes it more convenient for passengers. This is one of the reasons why Uber has become more popular when compared to traditional forms of PT (Uber, n.d).

Ride splitting can be environmentally friendly. In San Francisco uberPool has lowered CO_2 emissions. Across the first four months of 2016, uberPool usage has eliminated over 145 million kilometres of driving and saved more than 16,000 tons of C02 emissions (Uber, n.d).

Ridesourcing is also said to have several advantages. Miller and How (2017) state that ridesourcing gives users power by enabling them to access vehicles without actually having to own them, which can lower private ownership of vehicles. Additionally, Carranza, Chow, Pham, Roswell & Sun (2016) state that ride sourcing allows users to save costs on purchasing, operating and maintaining private vehicles. They also believe that ridesourcing allows customers to carry out other activities such as reading, talking, sending emails and so on instead of having to drive. It can, therefore, enable customers to use their time more productively.

However, ride sharing and ridesourcing/hailing and splitting also have some disadvantages. Occasionally, usage is low despite awareness and availability of the system. Circella et al. (2018) found that in California the majority of users had heard of services like Uber and Lyft however had never used the service. Respondents in the study from rural, suburban and urban areas reported that Uber or Lyft was available to use.

Some argue that rideshare and ridesourcing/hailing and splitting are not helpful in reducing road congestion and are not environmentally friendly. Schaller (2018) states that ride-hailing services like Uber and Lyft have actually contributed to increased traffic and road congestion issues across America. More people are choosing to use

such shared mobility services like Uber and Lyft which has now increased the number of users from 1.90 billion to 2.61 billion between 2016 and 2017. This is a 37% increase of more vehicles on the road. Schaller states that a total of 5.7 billion miles have been added in major cities metro areas like Boston, Chicago, Los Angeles, Miami, New York, Philadelphia, San Francisco, Seattle and Washington. An overall increase of 160% more driving on the street has been found in such cities, leading to additional road congestion. This is backed by the report done by the San Francisco County Transportation Authority across 2010-16 which found that ride-hailing services had actually increased vehicle hours spent on roads by “40,000 hours” on a typical weekday (San Francisco County Transportation Authority, 2018 pg. 33). This is estimated to be a 51% increase on time spent on vehicles.

Other studies done by Clewlow and Mishra (2017) found that ride-hailing services like Uber, Lyft had played a role in lowering the use of PT, especially the bus and light rail. While the number was little, a total “9%” reduction was seen across the 4094 respondents for lower PT usage after using ride-hailing services across seven major metropolitan areas in the United States.

Another negative effect of the growth of services like Uber and Lyft is a decline in taxi usage (Wallsten 2015). This can affect the livelihoods of taxi drivers.

In Denmark, there was poor perception of ridesharing service in rural areas which was deterring people from using the service (Nielsen, Hovmøller, Blyth & Sovacool, 2015). The poor perception was connected to a lack of availability in rural areas.

Safety was another concern regarding the use of certain forms of ride-sharing. Atkins (1990) states that the choice of transport can be affected by personal security. Chaudhry, Yasar, El-Amine and Shakshuki (2018) illustrates the ease of becoming a ride-sharing driver in many countries and the risk this poses to customers. Drivers’ criminal records did not receive adequate inspection. Kiplinger (2016) stated that the safety issue was exacerbated by transport companies using cheap fingerprint checks through private firms which fail to shortlist felony charges. A study by MERGE Greenwich (2018) also highlighted that respondents felt ride sharing services to be unsafe due to social discomfort. The idea of sharing a car with a stranger was a major barrier to using the service. This concern might be more related to privacy than safety.

Finally, the fact that Uber and Lyft present a change from traditional means of transport can itself be a deterrent to some users. The Ministry of Transport in New Zealand (n. d.) believes that people will not embrace shared transportation. It put this down to the familiarity of their current transport choice. The Ministry stated that alternatives will only be considered if they are cheaper, convenient and one feels safe using the systems. While they believe that a culture shift can change the way New Zealand embraces services like ride sourcing or sharing a positive experience is required for people to feel safe in using these systems.

2.6 Literature Review Summary

The existing research points to on-demand and flexible services as key to attractiveness and usage of a mode of transport, whether it is PT or shared mobility. Different kinds of shared mobility have different potentials and can support PT in many cases.

There are several gaps in the existing research that create an opportunity for further research. Limited work has been done into the feasibility of shared mobility in smaller cities. In New Zealand, the main studies of shared mobility are the ITF and OECD (2017) simulations for Auckland, the Ministry of Transport (n.d) work on urban transport and shared mobility and the Haerewa, Stephenson and Hopkins (2018) study on shared mobility usage in Māori communities. There is minimal work in New Zealand on the achievability of shared mobility in medium-to-low density cities, and none in Christchurch.

My research identifies if the PT system can really be supported by shared mobility in a medium to a low-density city like Christchurch. My study involves interviews with local policymakers, local shared mobility operators and a survey of the community in Christchurch to help gauge the potential for shared mobility to support PT in Christchurch. While my research is very case-specific it could still be useful for other similar regions across New Zealand that are experiencing similar issues of car dependency and poor PT usage. This research is also helpful in the Christchurch and New Zealand context by providing insight into whether the worldwide academic research and theories on PT and shared mobility are consistent with the local policymakers, operators and community's perceptions.

Chapter 3: Methods

My research looks at what factors are influencing low public transport (**PT**) usage in Christchurch and how might shared mobility systems support public transport in Christchurch. My first aim is to identify what is affecting low PT usage and what might change in the future in Christchurch. The second aim is to identify the perceptions towards shared mobility and discuss their potential in supporting PT in Christchurch. To understand my aims my methods, include:

1. Interviews with local policymakers to understand their perspective on what is affecting low PT usage in Christchurch and what may change in the future.
2. Interviews with local shared mobility operators to understand the potential of the shared mobility systems.
3. An online survey to understand the current transport usage patterns in Christchurch from the perspective of the local community and identify their perceptions towards shared mobility.

To achieve my first aim, I interviewed two local policymakers, Environment Canterbury (**ECAN**) and Christchurch City Council (**CCC**) to understand their perspective on what is affecting low PT usage in Christchurch and what may change in the future. I also carried out an online survey for the Christchurch community to understand their current transport usage which then enabled me to understand what reasons they believe are stopping them from using PT and what, if anything, could prompt them to use PT more.

To achieve my second aim, I interviewed two shared-mobility operators. The first was Yoogo Share. This is a car-sharing service for users but Yoogo offers “fully electric[al] cars” (Yoogo, nd). Yoogo’s idea is to offer a fully capable e-car fleet to the users for whatever the purpose as part of their daily usage.

Secondly, I interviewed SAVY, which is an on-demand ride-sharing service where riders share their ride and are pooled to provide affordable transport. The SAVY service used to only run in Queenstown. However, it is seen as a potential example of how other New Zealand cities could lower traffic congestion and enable better access to transport in areas with lower population densities. The SAVY service has also ended but it remains relevant as a case study of one of the first ride-sharing services in the South Island.

I tried to interview three other shared-mobility operators, Uber (ride-hailing/splitting), Spark Bikes (bike share) and Lime-S (electric scooter share), but was unable to obtain interviews despite trying for up to three months. Accordingly, my results for Uber, Spark Bikes and Lime-S are based on the survey results.

My discussion does not study Lime-S as a separate form of shared mobility because at the time I planned this study Lime-S was not expected to become as popular as it now has. I subsequently included it in my survey and tried unsuccessfully to obtain an interview. However, my discussion of Lime-S is under the head of Bike Share and as a contrast to Bike Share.

I studied these different forms of shared mobility systems to understand how such systems may change or compliment Christchurch's current PT system and in the future. This will help me achieve my second aim of identifying the perceptions towards shared mobility and discussing the potential of these shared mobility systems.

To accomplish my research, I have interviewed two policymakers and the two case study operators (shared mobility operators) in Christchurch. Further, I also carried out an online survey to understand how transport and current shared mobility systems are used in Christchurch. To analyse the interviews and the online survey, I used a mixture of quantitative and qualitative research methods as described in Sections 3.1 and 3.2).

I have broken down this chapter into smaller sections. Sections 3.1 describes the method design, respondents, data validity, records and analysis of the interviews. Section 3.2 follows the same structure to describe the online survey. Section 3.3 sets out how I implemented my research method.

3.1 Interviews

Interviews are a qualitative research method. Qualitative research methods are appropriate to develop an in-depth understanding of problems from the perspective of participants (Mack, Woodsong, Macqueen, Guest & Namey, 2005). I used the interview method to understand the different perspectives of policymakers and operators. Interviews capture information about an individual's values and opinions on a specific matter.

My interviews of the shared mobility operators gave me insights into what they see is fit for shared mobility in a medium to a low-density city like Christchurch. I was able to

understand what factors they believe are driving low usage of PT in Christchurch and what role shared mobility may play in supporting Christchurch's PT system. My interview with the policymakers helped me understand why they see PT numbers dropping in Christchurch and the future they envision. This process allowed me to comprehend how PT usage may change in the future in Christchurch.

3.1.1 Interviews Questions and Design

My interviews were semi-structured which meant that it allowed more flexible questioning and relevant answers. I wanted the interviewee to expand on their answers to allow me to follow up and gather more information around the area of my research. The semi-structured approach is backed up by Alshenqeeti (2014) who states that Rubin & Rubin (2005) claimed that semi-structured interview "allows depth to be achieved by providing the opportunity on the part of the interviewer to probe and expand the interviewee's responses" (2014, pg. 40). The full set of questions asked to the local policymakers and shared mobility operators can be found in Appendix E and F respectively.

The topics discussed in the interviews with local policymakers were:

1. PT in general and PT usage in Christchurch
2. Population Density
3. Impact of social and spatial barriers on PT
4. Shared Mobility
5. The future of PT.

The topics discussed in the interviews with shared mobility operators were:

1. Shared Mobility
2. The role of Shared Mobility in Christchurch
3. Role of Population Density and Shared Mobility
4. Barriers and Challenges around Shared Mobility
5. The future of Shared Mobility.

When setting up the interviews I made sure that most questions were open-ended to obtain more information from the respondents. I was looking to understand the issues from the perspectives of the policymakers and operators. Sullivan (2009) states that open-ended questions allow participants to provide answers that detail their understandings and feelings about a certain topic. By contrast, closed-ended questions can limit the information obtained, because the respondents may not be able to convey their personal feeling or perspective on the matter as the researcher may have restricted answers to choose from. I wanted more than just binary answers which reduce the potential diversity of the answers. Further, a close-ended question may have led the respondents feeling that I was leading them towards a certain answer which could lead to bias, as Sullivan (2009) highlights above. The open-ended approach has allowed respondents to provide answers in their own words and without the risk of my question imposing a bias on the answers. This has allowed me to understand the current strength and weakness of PT in Christchurch and what role shared mobility can play to support PT in the future in Christchurch.

3.1.2 Respondents

The four interviews lasted between forty-five minutes and one hour. The interviews were conducted from 15 January 2019 to 10 February 2019.

The two policy-makers participating in the interview are from ECAN and the CCC. The interview with ECAN had two representatives from ECAN. Their roles were Manager of Public Transport Strategy and Marketing and Manager of Public Transport Business Services and Improvement. The first role involves looking at managing, enhancing the current transport services and planning for future services in Christchurch. The second role looks at managing contracts and the total mobility service, which includes providing PT to those who cannot use PT. They were both happy to be identified in my report.

The representative from CCC whom I interviewed is a Policy Planner in the Transport Strategic Team. The CCC manages the core infrastructure for the city, which includes cycleways, on-street parking, off-street parking and many others. The Transport Strategic Team's role is to provide policy strategies to the CCC's Transport Unit which can then be used for operational changes.

The two shared mobility operators whom I interviewed were from SAVY, which is a ride-share company, and Yoogo Share, which is a car-share company. The respondent from SAVY is the Director of Business Development for GoBus Transport Limited. The role is to seek new opportunities for the company and once the systems are up and running then managing those systems. The role respondent from Yoogo Share is General Manager and they oversee the daily operations of the company.

As noted above, I had targeted and contacted other shared mobility operators which included Lime-S (electric scooter share), Uber (ride-hailing/splitting) and Spark Bikes (bike-share) but after numerous attempts over three months, I failed to arrange an interview.

3.1.3 Data Validity

My choice of respondents gives a measure of credibility and reliability to my data. I spoke with managerial-level employees of the policy-makers and shared mobility operators who are qualified professionals and are expected to have a sound understanding of their organisations' policies.

3.1.4 Data Records and Analysis

I recorded the interviews with the permission of each interview and took notes while I interviewed the respondents. I did not transcribe the interviews because I had the records to refer to when necessary.

My results in Chapter 4 summarise the interviewees' responses by theme. I chose not to include transcripts because the interviews were between 45 minutes to one hour long and transcripts would have been very lengthy.

I have set out the interviewees responses by themes as opposed to separate subheadings for each interviewee. This is because there are common themes across the responses and it would be less meaningful to record each interviewee's answer separately.

3.2 Online Surveys

I used online surveys for my research to understand what perceptions Christchurch residents have on general transport, PT and shared mobility. Surveying Christchurch residents helped me understand what reasons attract or detract them from using PT.

This is relevant to my first aim, which is to understand what is affecting low PT usage in Christchurch. Similarly, I was able to understand how open Christchurch residents are towards shared mobility**.** The responses were relevant to my second aim of identifying the perceptions towards shared mobility and discussing their potential in supporting PT Christchurch.

As identified in my literature review, Anderson et al. (2013) state PT administrators use key performance indicators (KPI) to determine how well their systems are operating for their users. However, the use of KPIs as the sole indicator of effectiveness is debated. ITF and OCED (2014) highlight that while KPI can be limiting in the sense that they do not capture external factors. I have therefore used both KPI and non-KPI factors in the survey questions to measure the effectiveness of PT.

3.2.1 Questions

I structured the survey into three sections: Section 1 concerned transport and PT; Section 2 concerned shared mobility; Section 3 concerned demographics. The full set of questions in the survey can be found in Appendix G.

The questions under Section 1 related to two topics:

1. Daily travel patterns to work
2. Perceptions and usage of PT in Christchurch.

The questions under Section 2 related to the following three topics:

1. What people understand shared mobility to be
2. Usage or openness to the usage of various forms of shared mobility
3. Positives and negatives behind using Shared Mobility

Section 3's questions asked for information on the following topics:

1. Postcodes
2. Gender
3. Age
4. Employment

5. Income

3.2.2 Pre-testing

I carried out pre-testing before finalising my online survey as I wanted to avoid errors which would give me a poor data set. To carry out pre-testing I designed a survey using methods that I identified in other academic researchers' works. For example, research from Dillman (2000) described a multi-staged testing process before an online survey is published. Andrews, Nonnecke & Preece, (2003) state that Dillman's multi-staged testing process includes four steps. Briefly, Stage one enables knowledgeable colleagues or analysists to examine the survey to make sure of its "efficiency, relevancy and format appropriateness" (2003, pg. 16). Stage two is asking a colleague the questions in the survey and requesting feedback on what felt right and what did not. Stage three involves a small pilot study with all the main procedures followed as if in a real survey. Finally, stage four involves a check-up with a person who is no way connected with the survey to allow that person to capture any errors or grammatical mistakes.

For my pre-test, I followed a similar method to Dillman's multi-staged testing process. I first sat down with my supervisors to make sure that the online survey was efficient and relevant to the research I was conducting. I next asked a friend to do the survey and asked them for their feedback. While I could not run an overall pilot study due to time constraints, I managed to ask a few family members to complete the survey just like someone would if this was actually published online. Finally, I got members from ECAN's transport team to check my online survey, who are outsiders in the sense they have no connection to the survey. By following these steps, I managed to identify many errors and clarity issues which enabled me to revise my survey. While time-consuming, the pre-testing phase allowed me to build an online survey that I believe answered my research questions adequately.

3.2.3 Designing the Online Survey

One issue I wanted to avoid was to make sure that my survey was not too long. Academic research shows that survey lengths affect users' response rate. Witmer et al., Jones (1999) and Sheehan (2001) conducted experiments with long and short surveys and found that shorter surveys have a higher response rate when compared to longer surveys. To avoid putting off potential responders because of survey length,

I kept a survey length of ten to fifteen minutes. I also kept a progress bar visible for survey users to give them a sense of progress as they move through the survey.

Another point I had to consider was the location request for demographic data comparisons. Frick, Bachtinger and Reips (1999) highlight that the response rate drops significantly for web-based surveys when a location is requested at the end of the survey. To avoid this issue Frick et al., (1999), states that putting this request at the start of the survey helps build trust. Explaining why the location information is being requested also improved response rates. The structure of my survey meant that I had to place the request for users to display their postcode near the end. However, I clearly explained in the request for the postcode that the information was relevant to assessing the availability of PT and shared mobility in that location and not to track the individual's locations.

I relied on research to design the layout of the survey to increase its effectivity. Couper, Traugott & Lamias (2001) and Preece, Rogers & Sharp (2002), suggest that keeping graphics, colour and the structure simple and minimalistic helps with the integrity of the survey. I avoided any elaborate colours and kept my survey simple. I only had a total of four graphics which displayed only when the four different shared mobility systems questions appeared. The graphics were implemented to provide a visual cue for users for each shared mobility system to allow them to provide more coherent responses.

Question length is important for clarity. Andrews, Nonnecke & Preece, (2003) and Nielsen (2000) suggested that shorter sentence are better for reading on a screen as many survey respondents tend to scan for keywords and phrases. I made sure that the questions were not too long to avoid any confusion and further kept the number of questions on the same page to a maximum of three.

Existing research has found that an introduction page is critical in online surveys. Introduction pages' help establish trust and encourage one to proceed with the survey (Andrews et al., 2003). Cho and LaRose (1999) explain that the introduction page can increase the likelihood of users completing a web-based survey if it states the purpose of the research, the benefits of the research, establish respondents' confidentiality, explains the methods and guarantees the credibility of the survey through a third party or established board. I implemented the processes identified by Cho and LaRose. I

clearly stated what is required from the respondents in my introduction page and assured the respondents that the answers will be confidential. My survey also had approval from the Human Ethics Committee (**HEC**) of my University. I displayed the necessary information from the HEC's approval letter and the approval number I received from the HEC, HEC 2018/79/LR, to establish the official ethical endorsement of my survey. The approval letter from the ethics committee can be found in Appendix D.

3.2.4 Sampling and Respondents

My target population was the current community in and around Christchurch City and Greater Christchurch because they are the potential users of PT and shared mobility. My sampling frame was limited as I had no email addresses or list of potential current users of PT. It was not possible for me to ensure that my sampling frame aligned with my target population as anyone could access the online survey on the different social media pages. However, I was fortunate to have my online survey link hosted through the local and regional council social media web pages. This hopefully reached my survey to my target population as Christchurch residents are more likely to visit or otherwise view the local and regional councils' social media pages.

A limitation of the online survey method could be that many of my target population do not have internet access or do not even use social media. Guildford (2018), claims that from the last census data more than 40% of the suburbs in Christchurch do not have access to the internet. However, the 2013 census shows that 79.2% per cent of residents/houses in Christchurch City have internet access (Statistics New Zealand, 2013). It is also possible that while the majority of individuals in Christchurch have internet access many do not use or have access to social media. Nevertheless, there is no information or studies about that in Christchurch. Fricker (2008) states that samples for internet-based surveys cannot be assumed to represent the entire population. I recognise that the data I collected may therefore not be representative of the target population. However, I believe the data I have captured will still reflect the opinions about the research topic of a significant sector of the target population.

Fricker (2008) also states that surveying a controlled base sample such as a list of names in a telephone directory can often lead to a better response rate. As I did not

already have control over who accessed the survey, it was not possible to obtain a response rate.

A total of 103 respondents responded to the survey over the two weeks. The respondents included their postcodes and all but five were either Christchurch or Greater Christchurch postcodes. Four postcodes were from Wellington and one from Dunedin.

3.2.5 Data Validity

I wanted to include shared mobility users as well as PT users in my sample to avoid having results that skewed my data heavily towards PT usage. For this reason, I wanted shared mobility operators to host my survey on their social media webpages as well. However, shared mobility operators were unable to host my survey. This meant that only the local and regional councils hosted my survey and their webpages are more likely to be visited by PT users as ECAN controls the PT system. Therefore, there is a risk of a bias towards PT usage in my data. I have explained this bias in Chapter 5 under the potential limitation section (5.4).

When running an online survey there is always the risk that the answers recorded will not be truthful because users feel that certain answers reflect better on them than other answers. To minimise this issue, I ran an anonymous survey. The Qualtrics online survey tool has a system which helped me generate an anonymous survey link. The anonymity is expected to have encouraged responders to answer more openly.

3.2.6 Online Survey data use for Results and Discussions Chapters

The online survey mainly collected quantitative data but there was also qualitative data in that some respondents used the “other” option in my survey to explain their answers. I analysed the qualitative data and interpreted them quantitatively where appropriate. I then used Microsoft Excel and Google Sheets to analyse and categorise the quantitative data. In the results section, I have used descriptive statistics methods to describe the data. The full raw data for the online survey can be found in Appendix H.

3.3 Recommendations for implementing this Methodology

Establishing good communication with the potential interviewees is valuable when developing the question set. By establishing good communication, I mean contacting

them in advance, gauging their interest levels, and determining that they are the appropriate person from their organisation to answer the questions. It is useful to prepare a “what to say to a potential interviewee” memo for oneself because that makes one come across as more professional and also helps convey the relevance of the interview more clearly when first establishing contact.

Working out the logistics of the interview in advance of the interview is also important. For example, the interviewee will need to know how long the interview is estimated to take, whether they will need to find a quiet room in their workplace, whether they will need to access a computer or other online material while responding to the interview, and so on.

Understanding the cultural background of the interviewee may be relevant if the interviewee is from a different cultural background. Knowing the cultural background would allow one to avoid making comments that might not resonate or could be misinterpreted. This was not a factor in the case of my interviewees.

Chapter 4: Results

The chapter presents the results from the interviews with policymakers and shared mobility operators and the results of an online survey. I first set out the results of the interviews and then the online survey. The results are summarised by research question and common observations across the responses followed by other relevant observations. Chapter 5 will interpret these results in light of the literature and place them in context.

I have described the responses as transport usage in “Christchurch”. I note that the postcodes of the respondents showed that 98 respondents lived in Christchurch. Four were from Wellington areas and one from Dunedin. I did not exclude the “Wellington” and “Dunedin” responses because it was possible that the respondents were temporarily living in these cities but were answering based on their experience in Christchurch. Alternatively, they could be permanent residents of Wellington or Dunedin who were temporarily living in Christchurch and using the transport here. Therefore, it was difficult for me to exclude their responses as irrelevant. In the event that one or more of these Wellington or Dunedin respondents did not base their answers on their experience of transport usage in Christchurch, I note that the answers form only a minor percentage of respondents (less than 5%) and any skew resulting from their responses is likely to be minimal.

4.1 Research Aim One: Identify what is affecting low PT usage in Christchurch and what might change in the future in Christchurch.

In the following sections, I will summarize the interview answers before providing the quotes. The full questions asked to the policymakers, shared mobility operators can be found in Appendices E and F respectively.

4.1.1 Current PT usage in Christchurch (Policymakers)

There is a general sense that PT in Christchurch was substantially poorer in quality when compared to other cities from around the world. The policymakers felt that larger populations improve PT usage and the fact that Christchurch had a lower population density, with the population spread out over a geographically large area, meant that PT was harder to access for some people.

Environment Canterbury (**ECAN**)	*Other outside cities don not measure well with Christchurch; When comparing to Auckland or Sydney their populations are large hence more usage. Christchurch scale is very different. PT is a lot slower which compared with other forms of transport like walking or biking.*
Christchurch City Council (**CCC**)	*Christchurch is spread-out which makes PT harder to run. Increase in population would possibly help increase PT usage in Christchurch.*

4.1.2 Factors affecting PT usage in Christchurch (Policymakers)

Workplace locations, housing locations and the status symbol of having cars were factors perceived by policymakers to be affecting lower PT usage in Christchurch. Another explanation for current low usage rates of PT was that the original bus network was aimed for the Central Business District (CBD). After the earthquakes accessibility to PT may have worsened as the CBD has been shut off for a while due to repair works. For people living in the suburbs spatially, PT services could be limiting. This meant that using private motor vehicles was a much more viable option when compared to PT. The issue of income also plays a role as people without the money to afford or access PT are less likely to use the PT system.

ECAN	*PT usage is lower– change in workplace location, change in housing location, maybe something with status symbol cars compared to the bus. Income can also be a barrier. Spatial – Distance is key, if PT is too far, the car is the way.*
CCC	*Housing location, distance and the status of the "car". Are all factors which can affect PT usage. Automobile dependency is high in Christchurch. People without money have big barriers: income. Plus, the bus network before the quake was aimed at the CBD.*

4.1.3 The Role of Density (Policymakers)

A common feeling between the policymakers was that Christchurch is a medium to a low-density city. PT is affected by population density: the more people in closer compact areas the better chance of a successful PT service.

ECAN	*Yes, Christchurch is a medium to low-density city. Higher population density can have its benefits for offering PT.*

CCC	*Yes, it is a medium to low-density city. The greater the density the higher the population which generally means more usage. Density plays a critical role.*

4.1.4 Economic Factor (Policymakers)

Economically, investing in PT in Christchurch was perceived to be cost-efficient when compared to investing in road infrastructure by ECAN. However, compared to other cities in New Zealand such as Auckland and Wellington, the PT system in Christchurch is not seen as a cost-effective option for shorter trips. The local and regional councils believe that people living in close proximity would allow shorter trips to be more cost-effective. This would allow more trips to be generated but with Christchurch's population being sparsely spread this makes delivering the services harder which comes at an economic cost.

ECAN	*PT is a lot cheaper when compared to investment in road infrastructure, PT in Christchurch effective when compared to Auckland and Wellington however for short trips this is not the case. People in close proximity would make delivery of the service easier. But in Christchurch that is slightly harder as the population is spread out.*
CCC	*PT service would be more economical and a lot better with people living in close proximity as delivering service would be easier, however, in a low-density city, it is harder.*

4.1.4 The future of PT (Policymakers)

An overall impression was that to attract current and new users to Christchurch's PT system, it would be necessary to improve the frequency of service, convenience, customer needs, journey times, the speed of service and network coverage. The regional PT goals and priorities will also need to be met, see (Appendix I). To meet these goals, policymakers would need improved resources in the future and hope that there would be fewer restrictions which can harm their planned progress. Finally, both the regional and local councils believe that technological advance will change the future of PT in Christchurch. Mobility as a Service (**MaaS**) or on-demand app-based

mobility will play a role for a connected single mobility service for a user to use on an on-demand basis. Shared mobility could very well be part of the system, offered for certain harder to reach corridors alongside the PT systems in the future.

ECAN	*Regional PT priorities need to be met, growth in frequency, increasing convenience for the users, understand the customers. Journey time and speed of service need to improve; network reach needs to improve to allow most people to have access. Still, major pockets of the city which needs better coverage. To meet these goals, the regional council believes they that for the short term answer is yes they are on track. But limited resources and restrictions can hinder this process. Currently, it is a long term vision with a short term plan. MaaS definitely has a big role and shared mobility will probably play a part in that. Technological advances will also change the PT structure. Shared Mobility will play a role alongside PT or in smaller corridors.*
CCC	*Growth in frequency, convenience, improved journey time and speed of service need to improve. Network coverage also needs to expand to new areas. Technology will play a major role in the future of PT. MaaS system could very well be one solution as app-based on-demand mobility gains popularity. Shared mobility could be part of these systems in supporting PT.*

4.1.5 Shared Mobility's Future and its role in supporting PT (Operators)

The general impression from the operators was that in the future they will look to work with local and regional councils to help improve their systems to better suit the needs of the customers. Operators believe that an integrated service with the current PT system in Christchurch would allow them to support PT and offer improved services to the local population. In the short term, operators believe they can offer a mix of services throughout New Zealand to support PT. For the long term, operators believe shared mobility may disappear but could exist inside a MaaS system, that is, under one connected transport system for users to use on an on-demand basis. Operators also expect that autonomous vehicles will be the future of shared mobility.

SAVY	*Working with local and regional councils, working with the community to better suit their needs. The better-integrated service with current PT services, the far better service we can offer to support PT. A mix of services around NZ as the regional*

	council's request to support PT. Autonomous vehicles will play a major role. Shared rides may disappear or may be integrated into MaaS service – lots of options for users to choose and ride as they wish, on-demand service etc. A future of connected transport systems
Yoogo Share **(YGS)**	*A future where they look to work with local and regional councils to see how they help but also improve their service. Grow into every major city and a future into autonomous vehicles. Shared Mobility may not exist or could be under MaaS systems with many on-demand services. A user connected future for transport that could very well be connected under one single system.*

4.2 Research Aim Two: Identify the perceptions towards shared mobility and discuss the potential of shared mobility supporting PT

4.2.1 Perceptions towards Shared Mobility (Policymakers)

Generally, policymakers believed that shared mobility was simply a "rent" or "buy" system to get from point A to B. Another way it was perceived was as a means of sharing transportation. Shared mobility has actually been trialled in Christchurch through a bike sharing system, while other services like hybrid on-demand vehicles are also being considered. These are known as Demand Responsive Transit (**DRT**).

ECAN	*A rent or buy systems to get from A to B. Shared Mobility has been considered, Bike-Share/Carpooling, plus mobility as service through an app which has options available. Plus, DRT a hybrid on-demand vehicle.*
CCC	*The sharing of transportation and has these systems have been considered.*

4.2.2 Perceptions towards Shared Mobility (Operators)

Operators perceived shared mobility as the shared use of vehicles where we move away from ownership towards a shared economy. Sharing means something that more than one person can use; for transport, this means allowing multiple people to use the service.

SAVY	*Anything that one or more person travels in, shared uses of vehicles. Moving from ownership to a shared economy.*

YGS	*Something more than one person can use. The systems are for multiple people to use. A sharing economy for transport.*

4.2.3 Potential of Shared Mobility (Policymakers)

There was a mixed perception of the potential of shared mobility to help PT and the environment. The interviewees discussed environmental benefits such as reduced air pollution from systems like electrical car-sharing services. However, they also noted research that states that ride sharing or ride sourcing services have led to car congestion. This is a major concern for the potential of some shared mobility systems, especially Uber and Lyft. But overall some shared mobility systems have the potential of improving transport.

ECAN	*Shared Mobility can help the environment and has the potential to benefit transport. However, studies have shown it can also increase car congestion. In short term probably can help but long term maybe not. There are however environmental benefits. Electrical vehicles will definitely help.*
CCC	*There are major concerns around Uber and Lyft services and the car congestion it creates. The potential benefits of shared transportation can be significant but they need to be carefully implemented. Electrical vehicles will play a role in reducing emissions and could play a role beside PT.*

4.2.4 Potential of Shared Mobility (Operators)

Both shared mobility operators felt that shared mobility is helping to fill the gap left by the PT system. The general impression was that shared mobility is part of the future mobility plans in Christchurch and their idea is to help move people more efficiently. Shared mobility systems involve a lower cost and offer on-demand service for customers. There is flexibility in booking times when compared to PT which might be restricted.

SAVY	*Filling the gap between taxis and busses – it is a niche market where the current gaps left need to be filled. We are an "on demand service" – we have no timetables, point to point or door to door service. A low-cost efficient system.*
YGS	*Part of the mobility jigsaw puzzle where we are trying to help people move about more efficiently and fill any gaps in current PT. We offer variety, pure electrical vehicles which means zero C02 emissions, we also have a lot more flexibilities with*

	bookings when compared to Christchurch's PT which has fixed times and uses.

4.2.5 Current Level of Shared Mobility in Christchurch (Operators)

The interviews highlighted that operators believed that shared mobility has the potential to expand and help support the PT system, especially in areas where PT service is not cost-effective or difficult to provide. One interviewee stated that when compared to the cost of maintaining and buying a car in New Zealand, shared mobility services could genuinely provide a more cost-effective option. Currently, one operator believes that in Christchurch, the popularity of shared mobility is rising after the widespread uptake of Lime-S. It is an expanding market and various opportunities exist to help popularize the different shared mobility systems.

SAVY	*Definitely can get much bigger, it is an improving market which means lots of opportunities exists especially in areas with no opportunity to use PT. Shared Mobility or on-demand transport is growing in Christchurch and New Zealand.*
YGS	*A lot of potential to expand, explore and maybe be even help support PT especially where PT may struggle. Car costs in NZ are expensive when compared to car sharing, so the scope is there for the systems to become bigger. Less than 1% market share before Lime-S, but after the arrival of some different systems like Uber and Lime-S the system has grown. Lime-S has played a major role in improving the share of such systems.*

4.2.6 Barriers and Challenges to Shared Mobility (Policymakers)

There were many barriers and challenges which were raised about shared mobility systems. This included the trouble of understanding how a single shared mobility system works when compared to other systems. There would need to be a lot of collaboration and concerted effort between public and private transport sectors to have the systems working properly alongside PT. The public perception behind car-dependent Christchurch would need to improve. The public may not be fully aware of the different shared mobility systems which would make the implementation of the systems, not cost-efficient. Also, car-based shared mobility could increase car congestion in the city. Regulations surrounding shared mobility forms would have to be clear and transparent to produce certainty for operators. Overall more trials and

feasibility studies would allow a better understanding of a new and dynamic concept of shared mobility.

ECAN	*Central single systems are harder to handle – a lot of private/public sectors need to come together to make sure the systems can actually work. Some of the shared mobility systems are harder but some are easier. People in Christchurch prefer car when compared to other forms of transport and this mindset has to change for shared mobility to succeed. If services like Uber and Lyft are left unchecked, it can lead to car congestion issues–research highlights. Need transparent regulations before shared mobility can function. New concept and we need more feasibility studies to understand the different systems better.*
CCC	*A single service may be easy to understand but how they interact with different shared mobility services can be complex. Plus, public perception needs to improve. Also car-dependent Christchurch- need to change people's current mode – needs more education about the systems. More trials and feasibility studies need to happen; the concept is very new but we are learning more every day.*

4.2.7 Barriers and Challenges to Shared Mobility (Operators)

Operators believe that the biggest barrier and challenge for shared mobility is getting people to try the services. Another major barrier was a limited budget. Expanding the system is very difficult in the early days after the system is set up as not many people know what services it offers. Another small challenge identified by one operator was the difficulty in devising what people would have to do if they wanted to change the service midway through a trip.

To help solve these challenges the different shared mobility services are trying to popularise the brand image. One operator is trying to be more prominent in Google search results to register with Google users and to convey the availability of services when customers look for travel options. Another operator is also trying to change the mindset of users about using shared mobility through various ad campaigns, training sessions to educate the public about the service, and the use of social media to reach new customers and current customers. Further, one operator is looking at incentives to get people to reuse the services and reward long term users with discounts.

The general impression was that improved awareness could help increase usage. Operators believe that over time a bigger budget would help them improve their current system. The operators concluded by saying that there is still a lot to learn about how people use and react to the different shared mobility systems.

SAVY	*Trying to get people to try our service is the biggest barrier. When you are new, you have a limited budget this makes brand awareness difficult.* *We were on the road making people more aware of the brand, getting shared rides like ours integrated into current PT systems or on search results on Google when users searching it appears to be an option. Awareness will be a key factor to help increases usage.* *Still, a lot to learn about how people will react to various services. How will people react if they had to change midway in service etc?*
YGS	*Trying to get the people to try the service first "get on board", what's the message of your service and getting people into the habit of using the service. Setting up from scratch which means there is less chance for your brand to grow especially when you are new and do not have that big of a budget.* *Spreading the news using our social media channels – very effective tool, targeted advertisements, vans and vehicles are carrying the brand strongly. Radio and Print also help majorly. Also looking into joint media campaigns - YGS is working with Hyundai and Meridian to promote their service. Help people learn the service by educating them etc. YGS has a training session on West End Car Parks to help people understand the system. They may also look at incentives, to get people to reuse their system or reward current and long term users.* *Time and money to improve our technology and the overall pipeline. Changing the mindset of the current users and through ad campaigns and more awareness etc. "Do you really need a second car?"*

4.2.8 Shared Mobility and Density (Operators)

Operators stated that shared mobility is affected by population density. They perceived Christchurch as a medium to a low-density city and believed that certain parts of the

city were very different from other parts of the city. This for them was a strong indicator of why shared mobility in Christchurch could work especially for one operator who thought that these pockets of the city might not be covered by current PT systems.

However, operators also recognised that higher population density means a lot more demand for service while lower population density meant there were fewer people to use shared mobility. Higher density cities generally have a more extensive PT system which encourages people to walk more and also limits the car parks available. The need to walk more, in turn, encourages the use of shared mobility. Thus, higher density cities are better for shared mobility. However, shared mobility could be an effective tool for cities of lower population density where PT systems fail to reach potential customers.

SAVY	*Christchurch is a medium to low density certainly and population density does play a role. Every place inside the city is different. This is why shared mobility could be important to address different areas. Lower density probably hinders shared mobility because there are fewer people to use it, however having targeted shared mobility in corridors where PT is less used could help with usage. Higher population densities also mean that less car parking and more walking, which could make shared mobility more attractive to users and future customers.*
YGS	*Density definitely plays a role, higher density allows a lot more vehicles and demand is a lot higher. Bigger population in urban centers does really help improve shared mobility usage. Christchurch is very different all around and there are corridors where shared mobility could work especially in areas where PT is not well supported. Generally, higher density cities have better PT system which encourages walking and limits car parking. Walking encourages shared mobility usage as many of the services are scattered throughout the city.*

4.3 Community Response – Online Survey Results Structure

This section will start by looking into the general demographics of survey users, followed by current transport usage patterns and perceptions towards shared mobility. The full online survey data can be found in Appendix H.

4.3.1 Data Set Demographics

The online survey had a total of 103 respondents. Of these, 46 (45%) identified as males, 56 (54%) as females and 1 (1%) identified as “other not listed” for their gender. This was representative of the census data of 2013 in Christchurch which also showed that Greater Christchurch had a higher percentage of females compared to males (Statistics New Zealand, 2013).

In terms of age (Figure 3), the highest number of respondents were in the 41 to 50-year category. There were 24 (23%) respondents in this category. This aligned with the Census of 2013, which found that 40 to 54 year category had the highest number of people in Christchurch (Statistics New Zealand, 2014). The second highest in my survey results was the 21 – 30-year age group at 23 (22%). The 31 to 40-year group formed 17 (17%) of respondents.

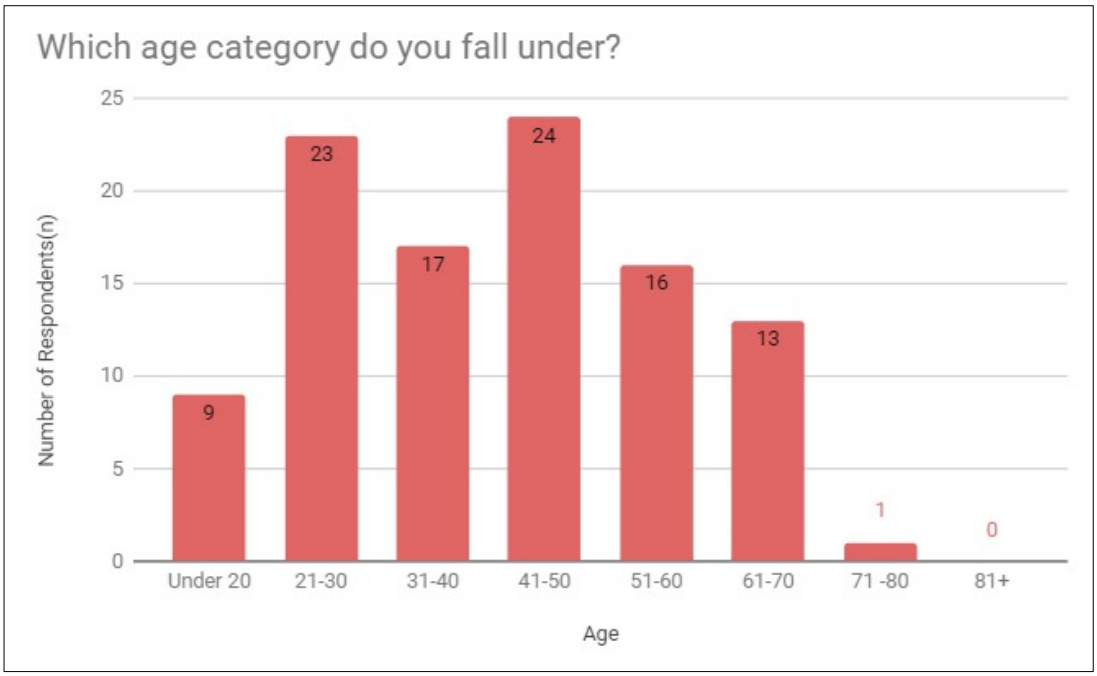

Figure 3: Age category of the data set

By occupation status, 45% were employed (full-time) and 24% were employed (part-time) (Figure 4). This data set is also representative of the census data of 2013 in Christchurch which showed that employed (full-time) and employed (part-time) were the highest two recorded occupation status (Statistics New Zealand, 2014).

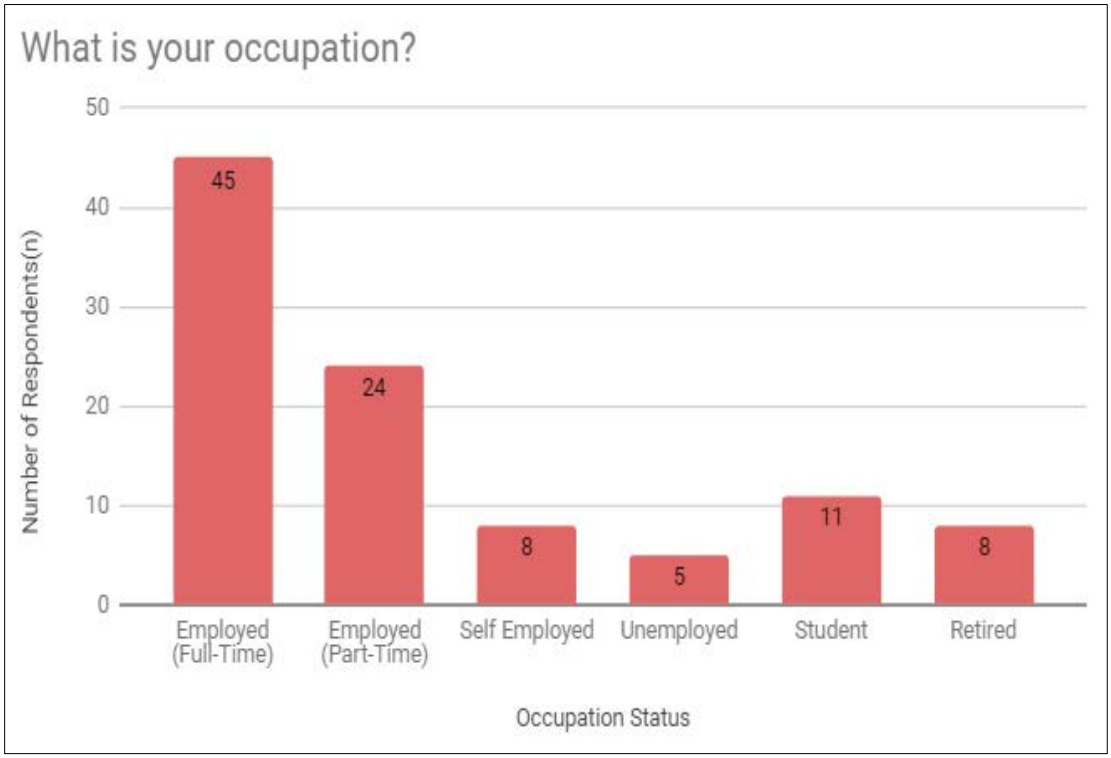

Figure 4: Occupation of the data set

Household income (Figure 5) showed that the highest category of respondents earned more than $150,000 per household (11%). The next two categories which came second equal were $10,000 to 20,000 (9%) and $60,000 to 70,000 (9%) respectively. At least 28 respondents did not provide an answer to this question. The median household income from the 2013 census of Christchurch City was $65,000 (Statistics New Zealand, 2014). My data set had more respondents earning above $70,000 (39) per household than below (36). However, it is possible that the respondents who chose not to provide an answer to the question on household income would have increased the number of respondents from households earning below $70,000.

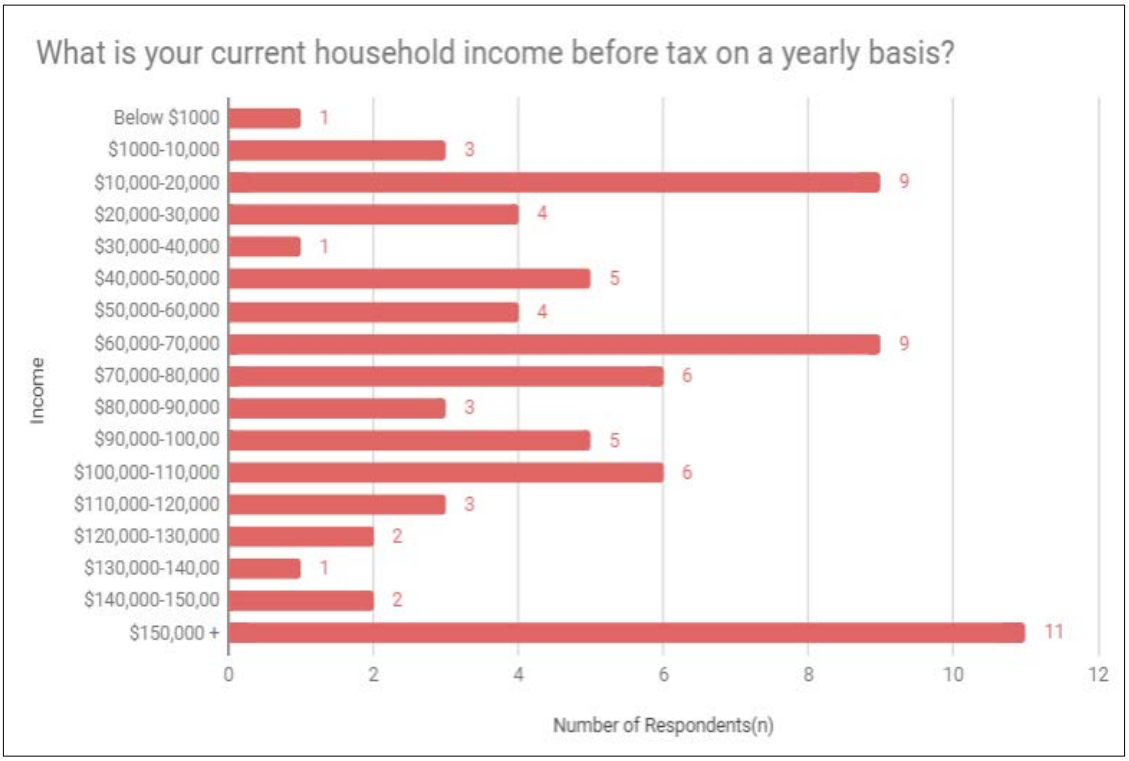

Figure 5: Household income spread of the data set

4.3.2 Research Aim One: Identify what is affecting low PT usage in Christchurch and what might change in the future.

This section presents the results on the frequency of transport used by respondents for the daily, weekly and monthly travels. As these questions were multiple choice, and people could choose multiple options, totals may not add up to 103.

4.3.2.1 Community Transport Usage

Figure 6 shows the modes used by individual respondents for most days in Christchurch. Walking was the most used mode, selected 51 times (54%). Car was the second most used mode at 39 (39%) and biking was next at 19 (20%).

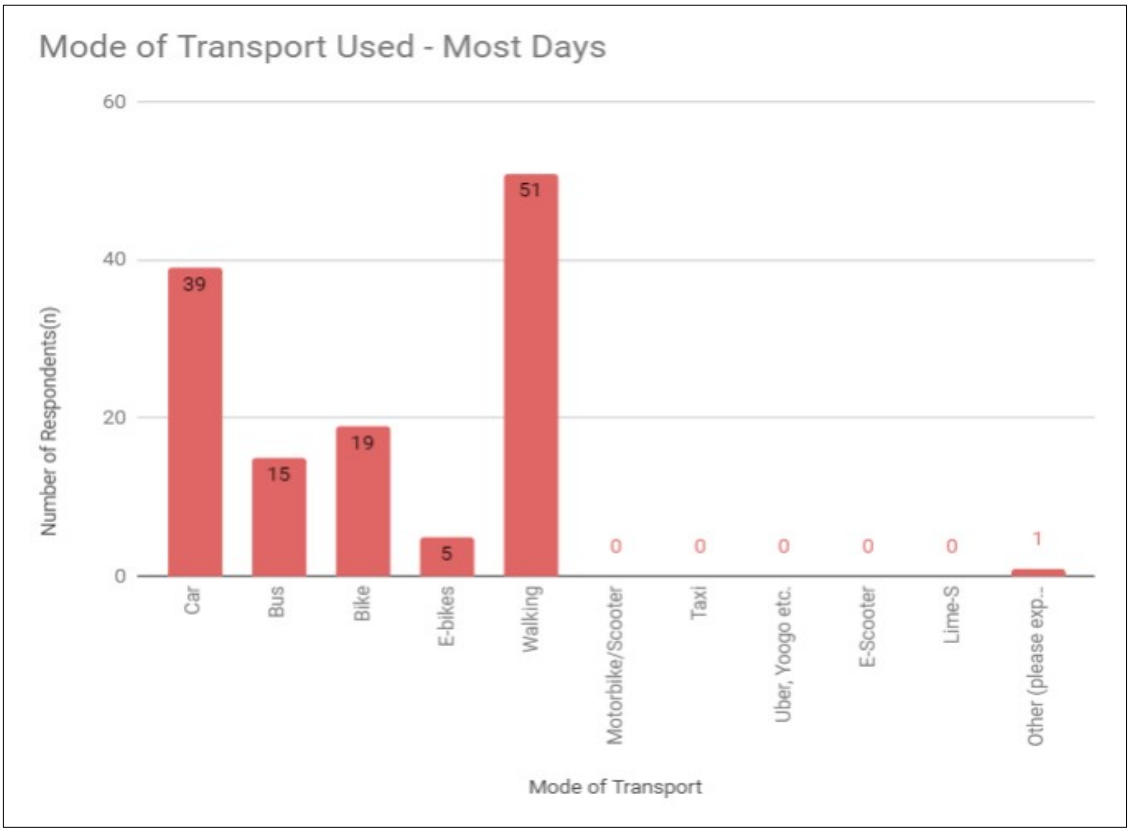

Figure 6: Frequency of daily travel

The most-used mode of transport for 3-4 times per week (Figure 7), car usage was highest (selected 16 times or 13%). Bus usage was second at 11 (9%) and biking and walking are the next two at 7 (6%) and 6 (5%) respectively.

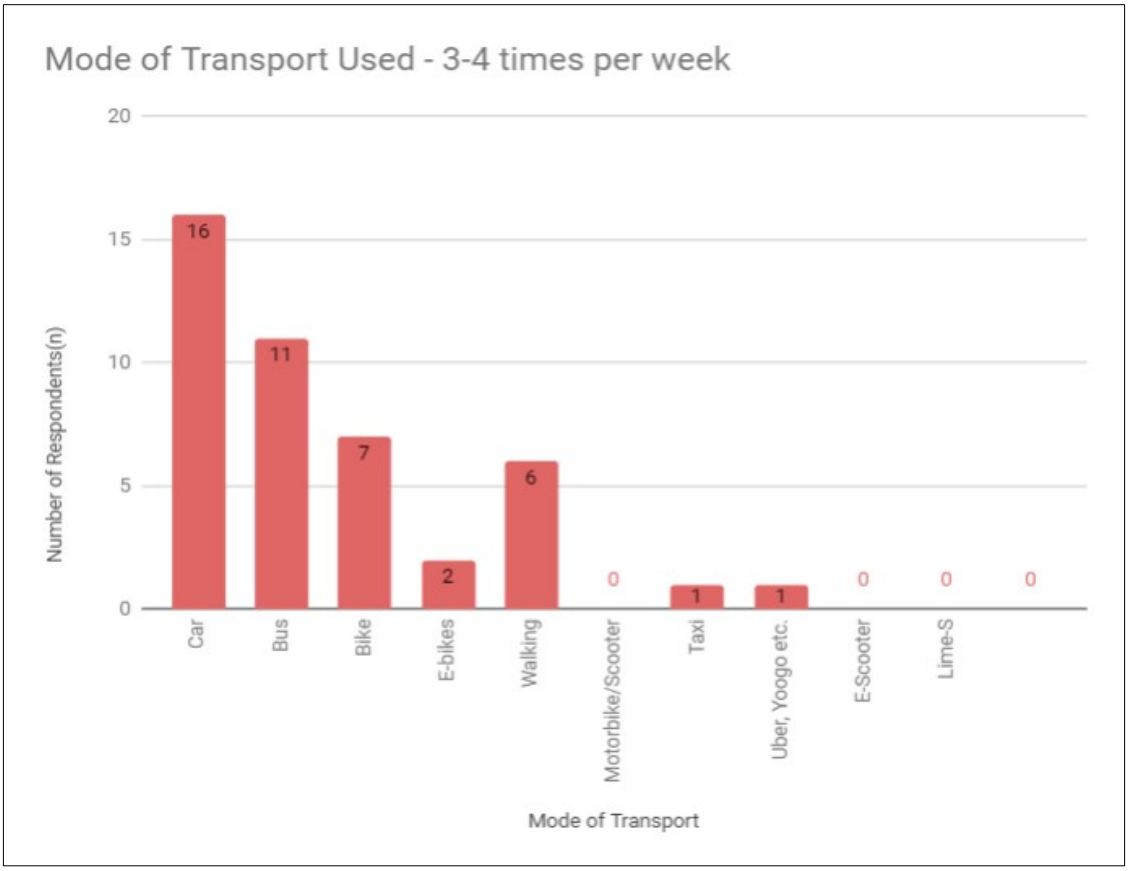

Figure 7: Frequency of daily travel

Figure 8 sets out the frequency of mode of transport used 1 – 2 times per week. The car was once again the most used at 26 (31%) followed by walking at 24 (29%) and bus at 22 (27%).

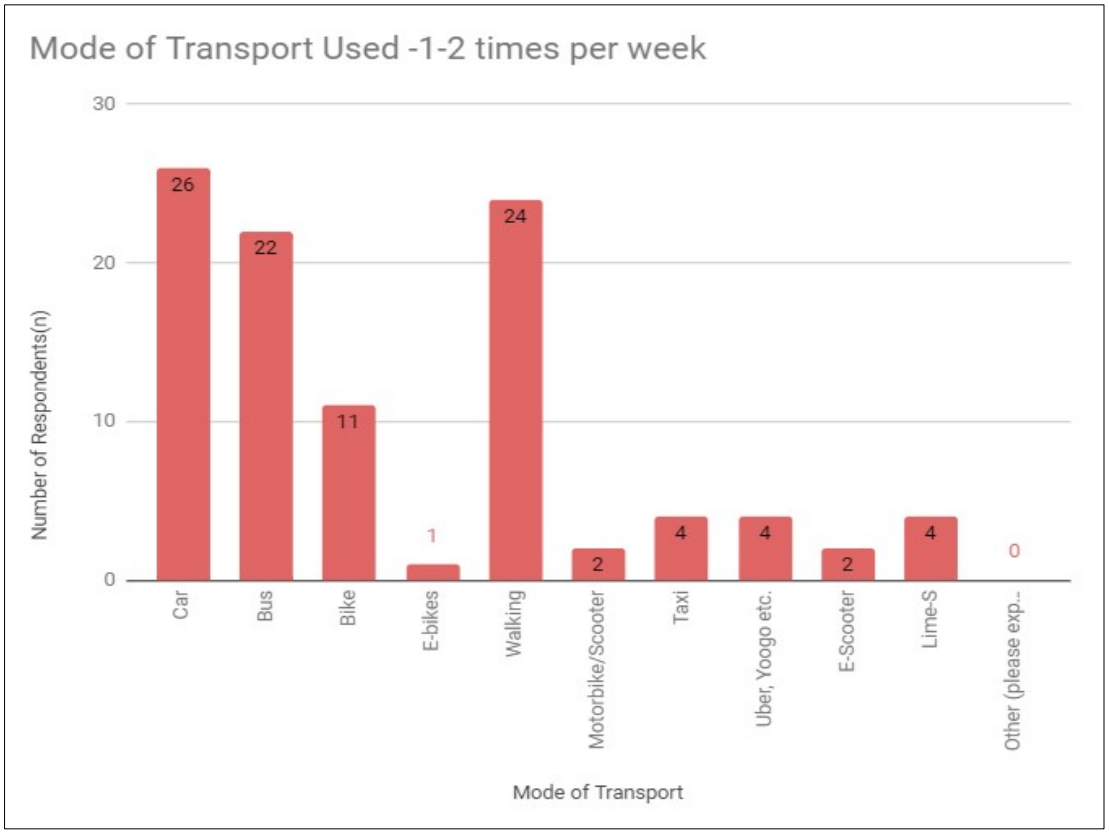

Figure 8: Frequency of daily travel

Figure 9 shows the frequency of modes of transport used once a month. Bus was the highest at 26 (31%), with Uber and Yoogo at 24 (29%), and Taxi and Lime-S at 20 each at (24%).

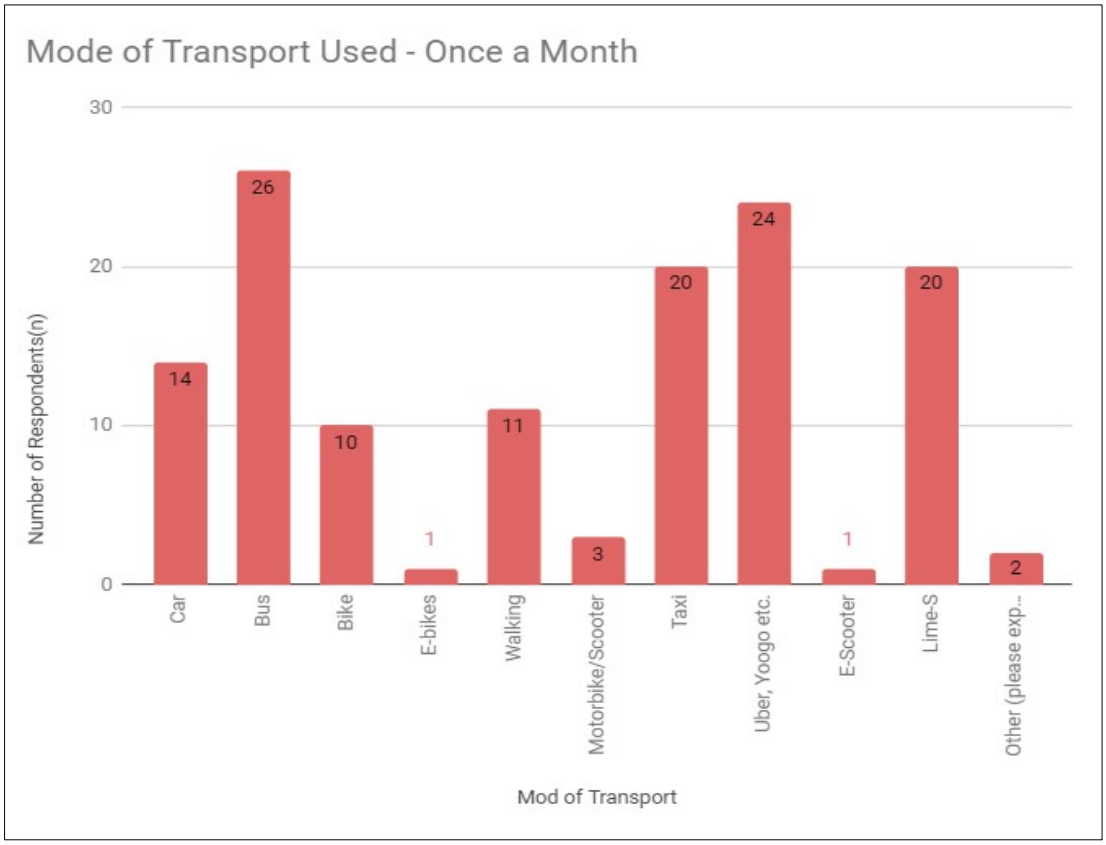

Figure 9: Frequency of daily travel

Figure 10 shows the responses to the question “which mode of transport have you never used?” The top three never used were E-Scooter, Motorbike / Scooter and E-bikes: 87 (82%) of respondents had never used E-Scooters; 81(80%) of respondents had never used Motorbike / Scooter; 81 (73%) of respondents had never used E-bikes.

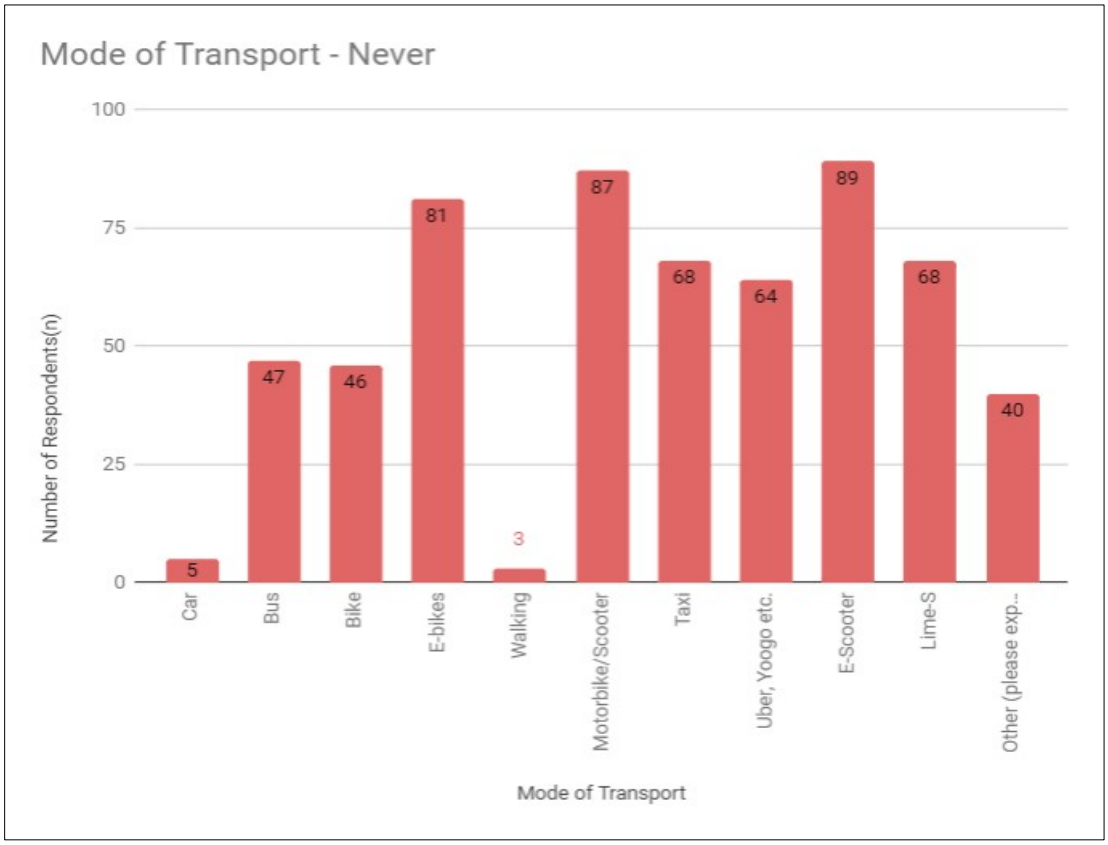

Figure 10: Frequency of daily travel

4.3.2.2 Community PT Usage

This section presents the results of PT usage patterns in Christchurch.

From the total number of 103 responses to the question “how do you feel about using PT?” 17 respondents (18%) felt “mostly positive”, 39 respondents (40%) felt “positive”, 40 respondents felt “neutral” (find it reasonable but use other if more convenient) (38%), and 7 found it “negative” (dislike it) (see Figure 11).

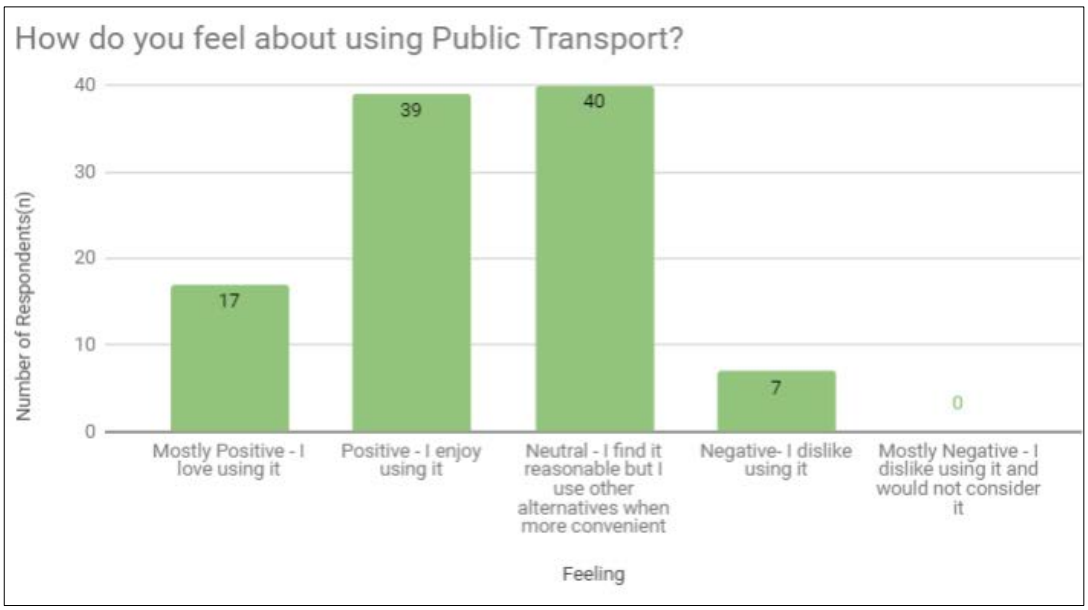

Figure 11: PT usage feelings for Christchurch

The respondents who answered "never" to using the bus (PT in Christchurch) (47) in Figure 10 were asked what their reason for not using PT over the last 3 months (Figure 12). The top reason (8 respondents or 17%) was that "current bus routes don't suit me"; the second (7 respondents or 15%) was "service is too slow"; tied at third place (6 respondents or 13%) were the reasons "services aren't frequent" and "other". From the comments added to the "other" response, three respondents felt bike usage was far more convenient and two respondents thought car travel was far more convenient when compared to PT. The other two comments were about the availability of PT, time and distance for PT.

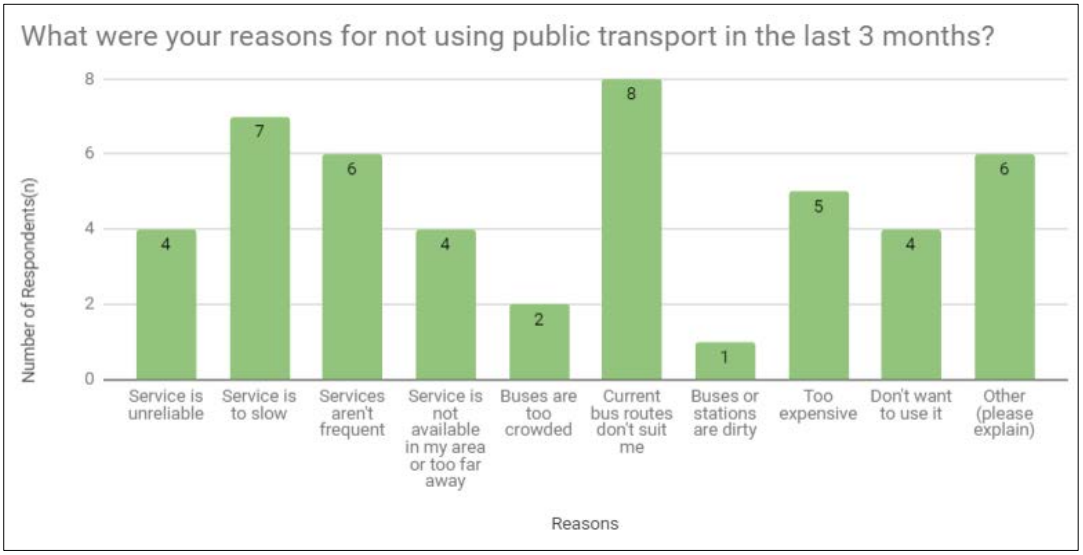

Figure 12: Reasons for not using PT in Christchurch

The same 47 respondents who answered that they had “never” used a bus were asked what, if anything, would make you consider using PT more often. However, only 42 respondents completed the question and 5 respondents did not answer the question and skipped. Figure 13 sets out the responses of the 42 who answered the question: 11 respondents (26%) stated that “higher frequency of service” (more buses and bus routes) would encourage them to use PT. The cheaper cost was the second most-chosen first response, with 7 respondents (17%) choosing this option. Other factors came in at third equal (14%): these were “more bus stops”, “closer to home” and “other”.

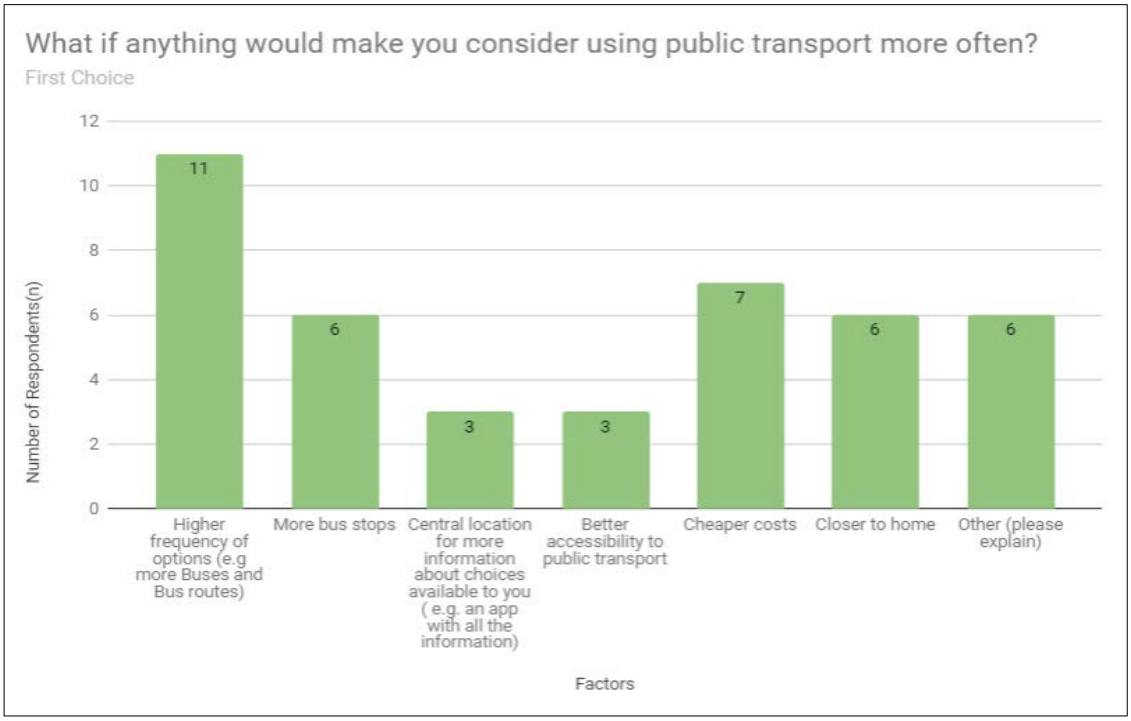

Figure 13: Factors to help you consider PT more often in Christchurch

4.4 Research Aim Two: Identify the perceptions towards shared mobility and discuss the potential of shared mobility in supporting PT

This section focuses on what the respondents understand about shared mobility, as seen through the responses in the online survey.

4.4.1 Community on Shared Mobility Awareness

From the 103 respondents, 40 (38.8%) respondents reported having heard of the term "shared mobility" while 63 (61.2%) respondents stated that they had not heard of the term "shared mobility" (Figure 14).

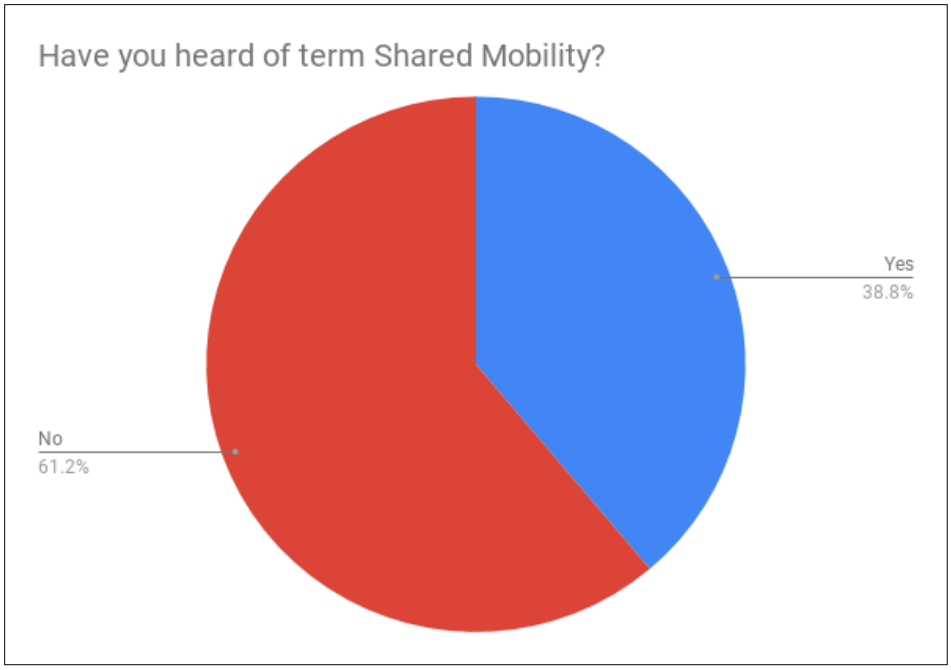

Figure 14: Awareness of shared mobility, Yes (blue) and No (Red).

I also asked respondents if they had heard of the terms "car-sharing", "ride-sharing", "ridesourcing / ride-hailing or ride-splitting" and "bike share" (Figure 15). These are the four shared mobility systems my research addresses. Ninety-four respondents (xx) were aware of car-sharing; 88 were aware of ride-sharing; 65 had heard of bike-sharing; 25 had heard of ride-sourcing/ride-hailing or ride-splitting. I also collected responses for how many people had heard of e-scooter (65 people had) but e-scooter was not part of my case study for the reasons explained in Chapter 3, Method. As explained, however, I did use the e-scooter results to compare with bike-share because e-scooter has since replaced bike-share in Christchurch.

I used examples of non-Christchurch systems to ask respondents how much they knew about shared mobility. This is because there are few shared mobility systems in

Christchurch and there is a chance that the respondents may not have heard about the Christchurch examples but still be aware of an example of shared mobility in other New Zealand cities. Non-Christchurch examples of shared mobility that I used were Onzo (Bike-Share, Wellington), Cityhop (Car-Share, Auckland). SAVY is originally from Queenstown but as explained in the methods in Chapter 3 it is being used as an example for my research.

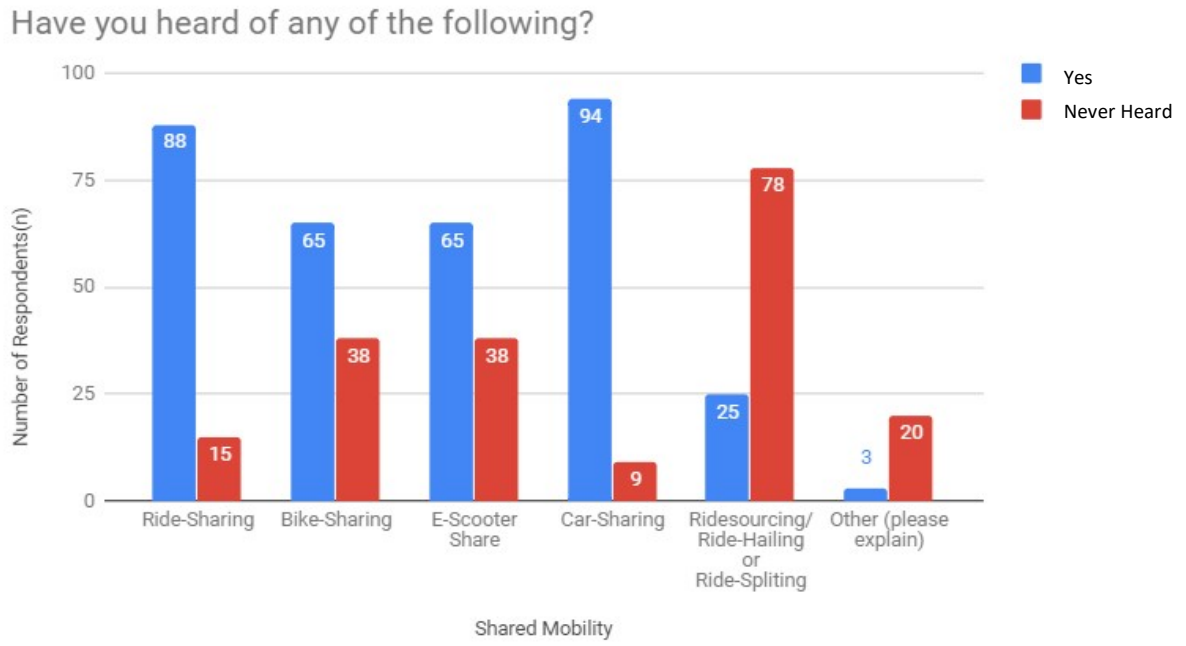

Figure 15: Shared Mobility awareness by different systems. Yes (Blue), Never Heard (Red)

4.4.2 Shared Mobility Availability and Usage Patterns: Bike Share

The usability of the different services under bike share and e-scooter share showed that Lime-S had the highest number of users to have “used the system in the past” 16 (16%) or a “current member” 25 (26%), while Spark Bikes was second for “used the system in the past” 23 (24%). Overall “never used” was the highest response for most of the services with the response for Onzo recording 99 respondents (96%) to have never used the service (Figure 16).

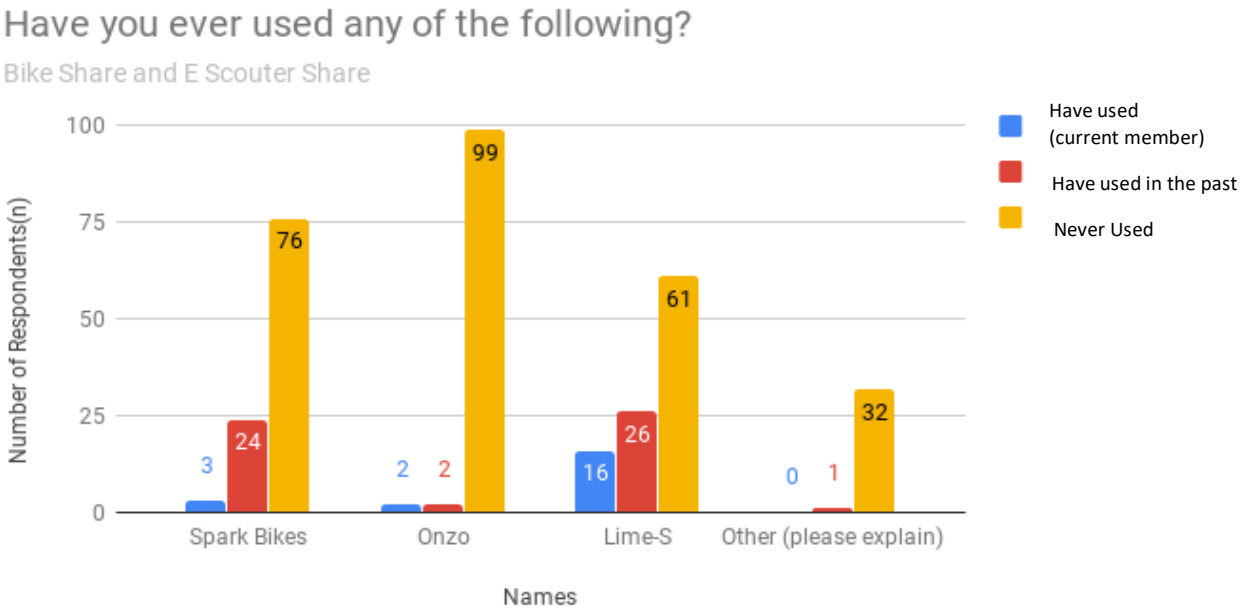

Figure 16: Usage of shared mobility in the data set

Figure 17 illustrates the responses to the question of whether bike share and e-scooter share were available in the respondent's area. Lime-S was the most locally identified 71% while 49% had never heard of Spark Bikes and 60% had never heard of Onzo.

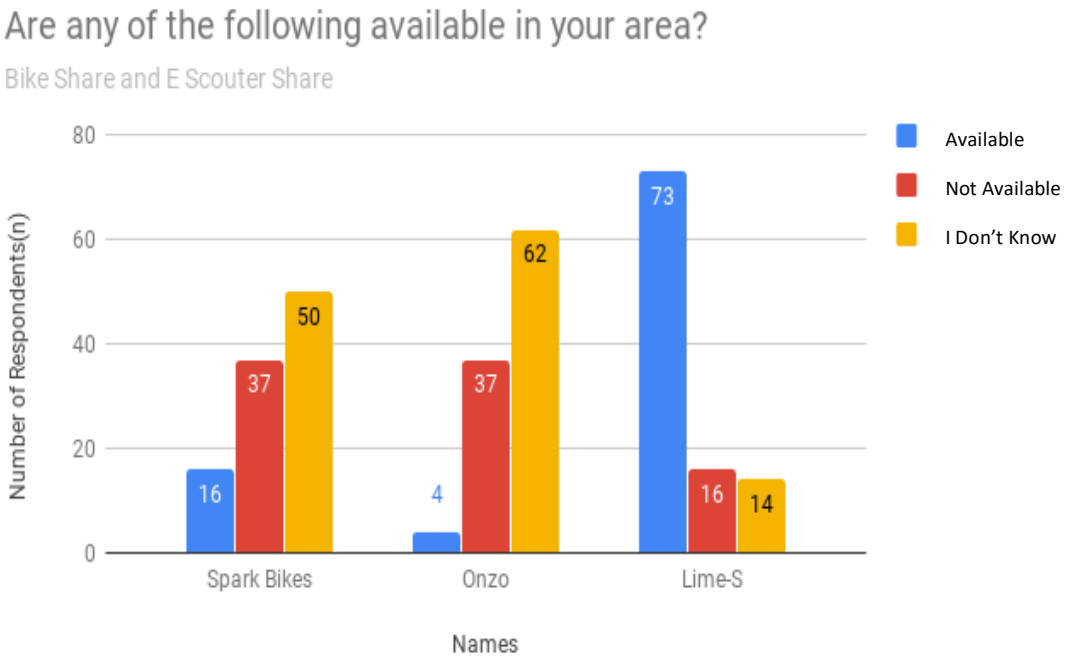

Figure 17: Availability of shared mobility for the data set

Finally, when asked if they would use bike-share or e-scooter services (Onzo, Spark-Bikes and Lime-S) if they were available in their area, 30 respondents (37.9%) said “yes” and 41 (39.8%) said “maybe” while 23 said “no” (22.3%) (Figure 18).

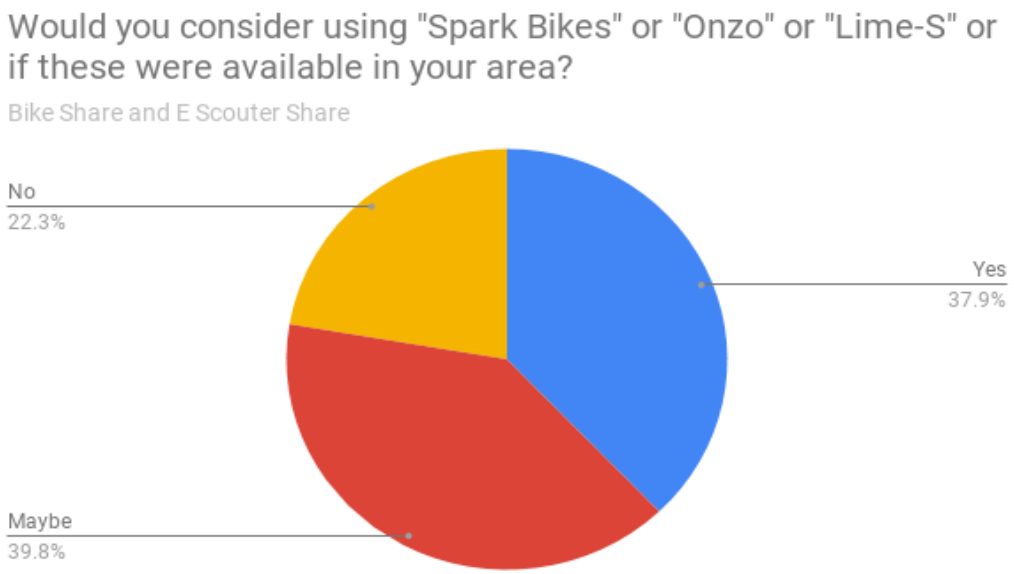

Figure 18: Yes (Blue), Maybe (Red), No (Yellow)

4.4.3 Shared Mobility Availability and Usage Patterns: Car Share

The usability of the different services under car share found that Yoogo Share had the highest number of users to have “used the system in the past” at 6 (6%) or a “current member” at 8 (8%) with others all rarely being used. Once again “never used” was the highest trending bar line for most of the services with Yourdrive having the highest at 101 (98%) and Cityhop having the second highest at 99 (96%) (Figure 19).

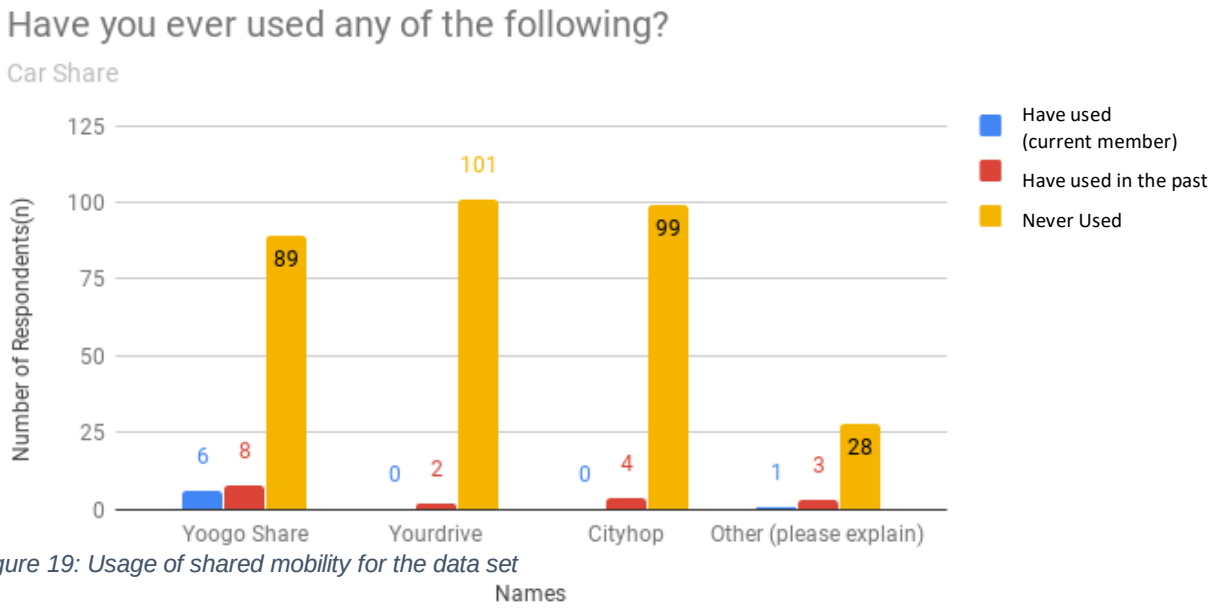

Figure 19: Usage of shared mobility for the data set

From the availability perspective, Yoogo Share once again had the most respondents at 39% saying that the service is “available” in their area. Both Yourdrive and Cityhop had the highest “I don’t know” if they are available in my area at 76% and 73% respectively (Figure 20).

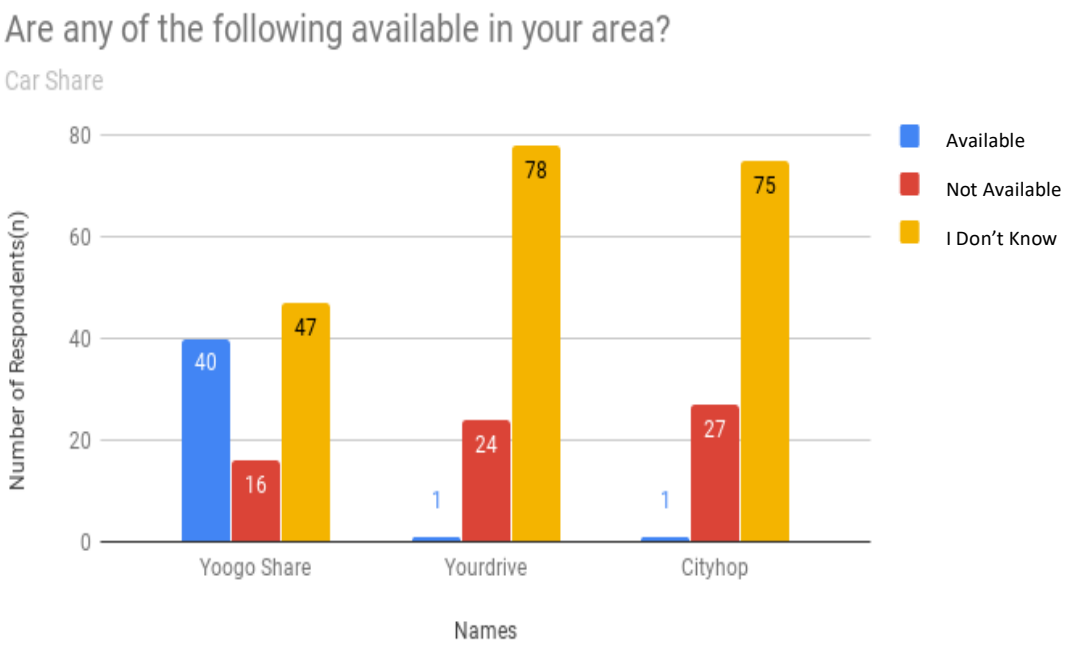

Figure 20: Availability of shared mobility for the data set

Finally, when asked if you would consider using these services if they were available (Figure 21). 30 respondents (29.1%) said “yes” and 33 (32%) said “maybe” while 39 said “no” (38.8%)

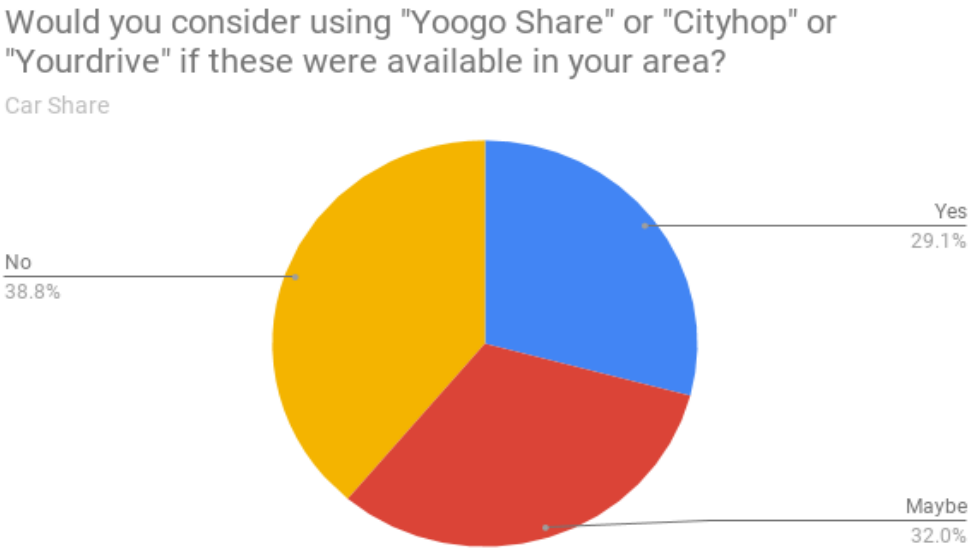

Figure 21: Yes (Blue), Maybe (Red), No (Yellow)

4.4.4 Shared Mobility Availability and Usage Patterns: Ride Share

The usability of the different services under ride share demonstrated that the Airport Shuttle Service had the highest number of users to have “used the system in the past” at 73 (75%) or a “current member” at 3 (3%). Once again “never used” was the highest trending bar line for most of the services with SAVY, Driving Miss Daisy and GOVbus all having over 100 respondents (97%) saying that they never used the services (Figure 22).

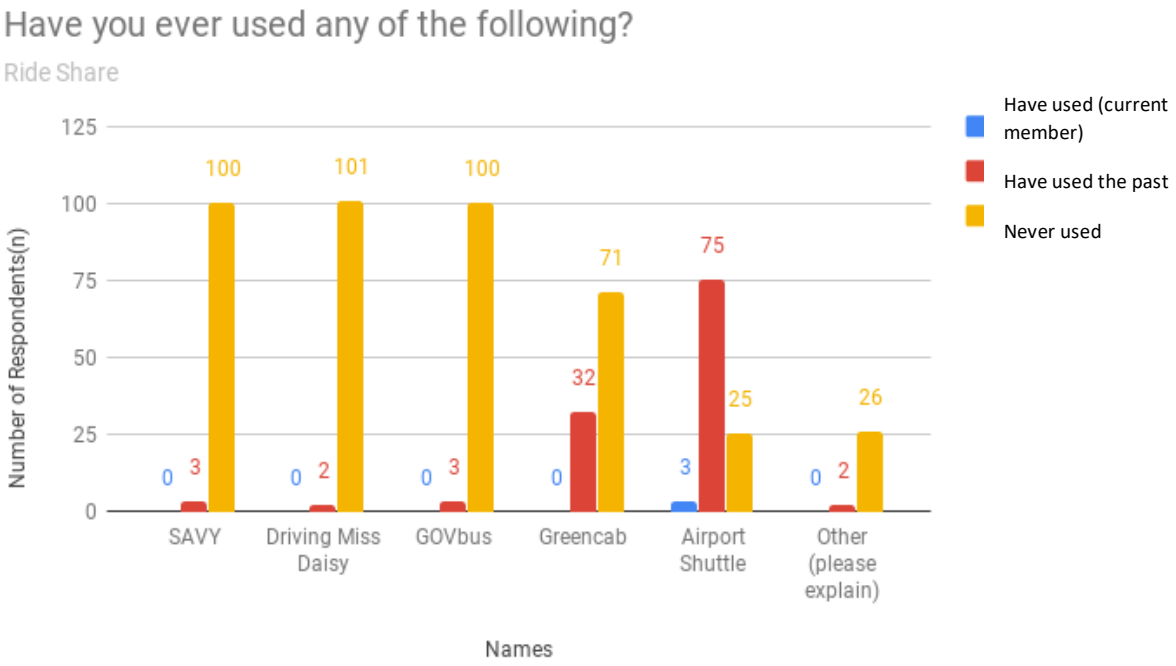

Figure 22: Usage of shared mobility for the data set

Availability of different ride share services showed that Airport Shuttle Service had the highest number of users to have responded saying that the service is “available” in their area at 79%, with Driving Miss Daisy at second with at 47% and Greencab at 38%. The highest “I don’t know” if they are available in my area was from GOVbus at 85% (Figure 23).

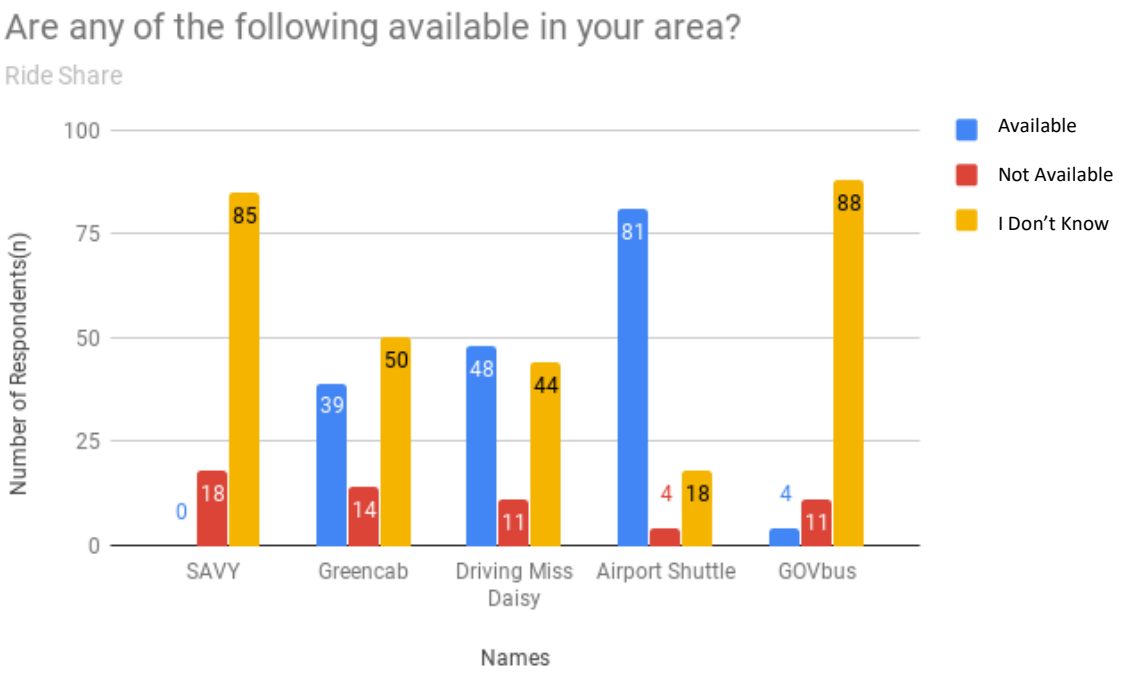

Figure 23: Availability of shared mobility for the data set

Finally, when asked if you would consider using these services if they were available (Figure 24). 39 respondents (37.9%) said "yes" and 45 (43.7%) said, "maybe" while 19 said "no" (18.4%).

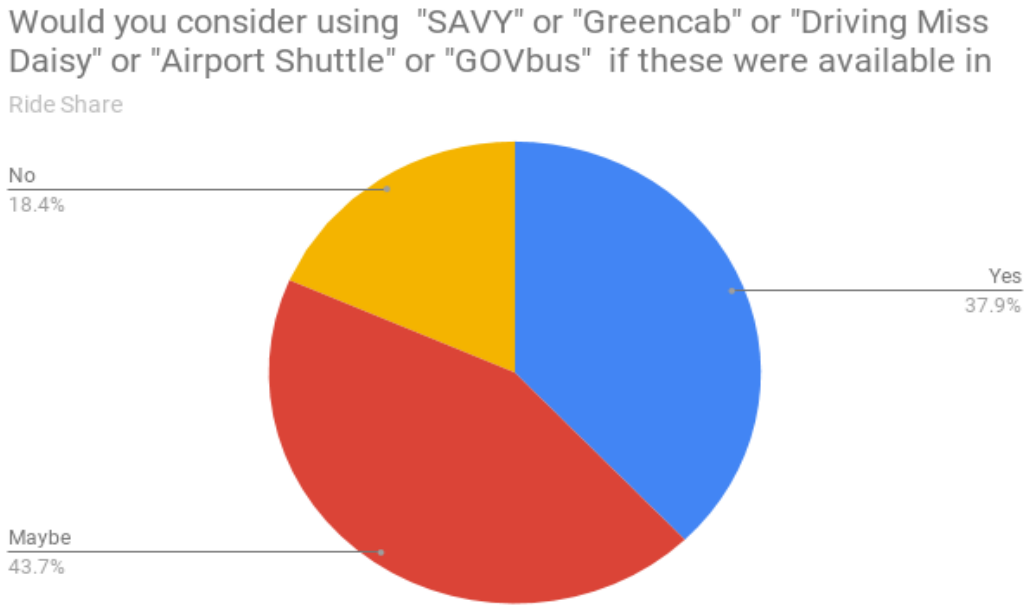

Figure 24: Yes (Blue), Maybe (Red), No (Yellow)

4.4.5 Shared Mobility Availability and Usage Patterns: Ridesourcing/ Ride-Hailing or Ride-Splinting

The usability of the different services under ridesourcing/ride-hailing or ride-splitting showed that Uber had the highest number of users to have “used the system in the past” at 29 (30%) or a “current member” at 30 (31%). Once again “never used” was the highest trending bar line for most of the services with Zoomy and Ola having 92 respondents (89%) and 90 (87%) respectively to have never used the service (Figure 25).

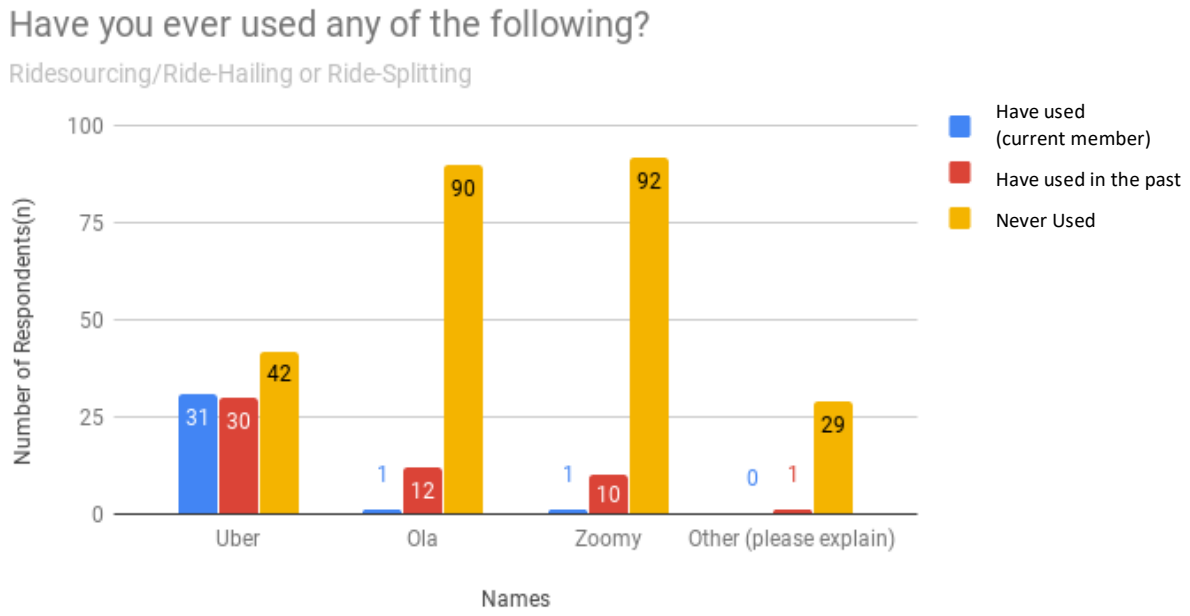

Figure 25: Usage of shared mobility for the data set

Availability for in your local area for the different services under ridesourcing/ ride-hailing or ride-splitting highlighted that Uber had the highest at 89%. While Zoomy recorded the highest number of “I don’t know” if they are available in my area at 77% (Figure 26).

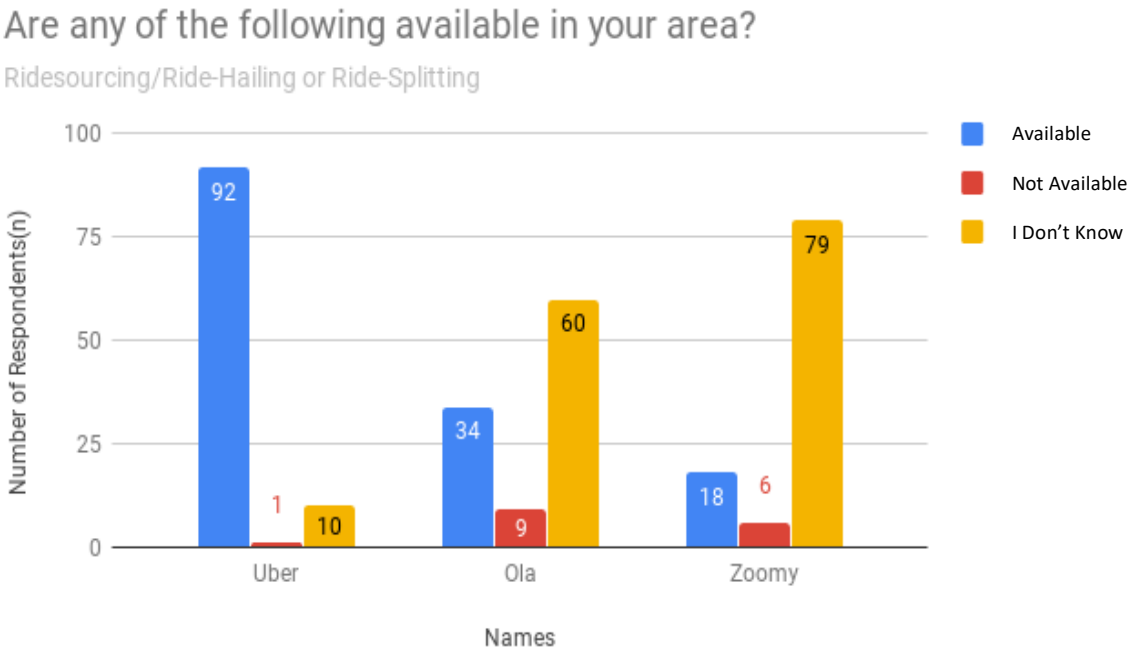

Figure 26: Availability of shared mobility for the data set

Figure 27 shows how respondents would use these services if they were available. Interestingly, 43 respondents (41.7%) said “yes” and 37 (35.9%) said, “maybe” while 23 said “no” (22.3%).

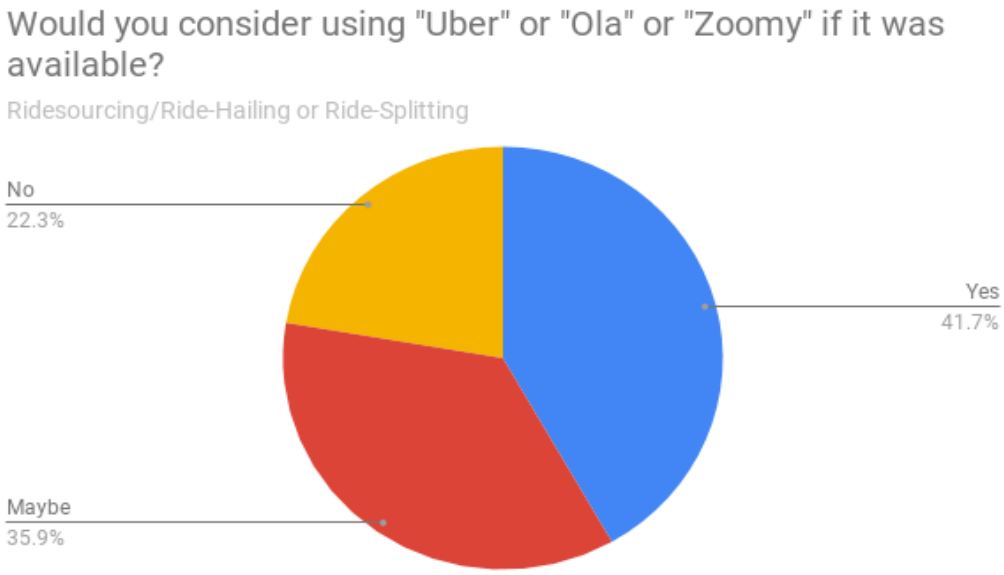

Figure 27: Yes (Blue), Maybe (Red), No (Yellow)

4.4.6 Success of the different Shared Mobility Systems

This section summarizes the results of the survey relating to why some of the shared mobility systems have been successful. For each system that I have surveyed, I set out the top three reasons for usage that respondents provided. A point to note is not everyone had to choose an answer to proceed. This means that not all the numbers will add up to 103.

For Bike Share (Spark Bikes) the top three reasons for usage, were “economical” (8 times), “easy to use” (7 times) and “convenience” (7 times). For Lime-S, the top three reasons were “easy to use” (35 times),” convenience” (28 times) and “availability in my area” (27 times) (Figure 28).

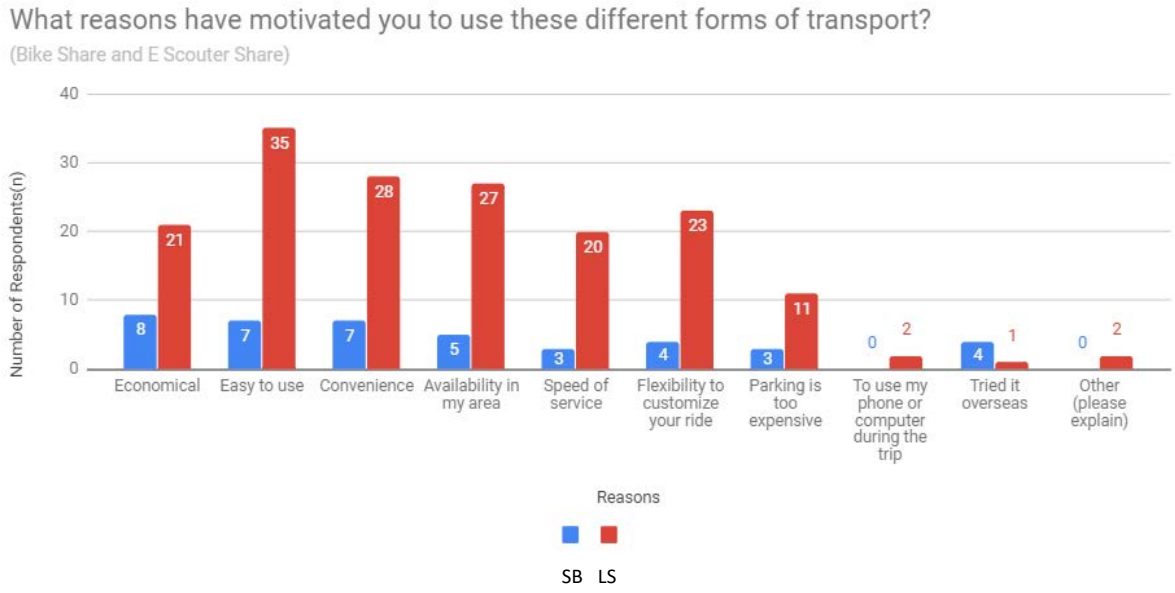

Figure 28: Spark Bikes (SP) / Lime S (LS) service success according to the data set

Yoogo Share was one example of a car share. The top three reasons behind its usage were “economical” (9 times), “easy to use” (7 times) and “availability in my area” (7 times) (Figure 29). Yourdrive is the second option under car share and this had a limited amount of responses. The top three reasons behind the usage of this service were “economical” (2 times), “availability in my area” (1 time) and “parking is too expensive” (1 time). Cityhop was the third option under car share and this also had a limited amount of responses. The top two reasons behind the usage of this service were “easy to use” (2 times) and “flexibility to customize your ride” (2 times).

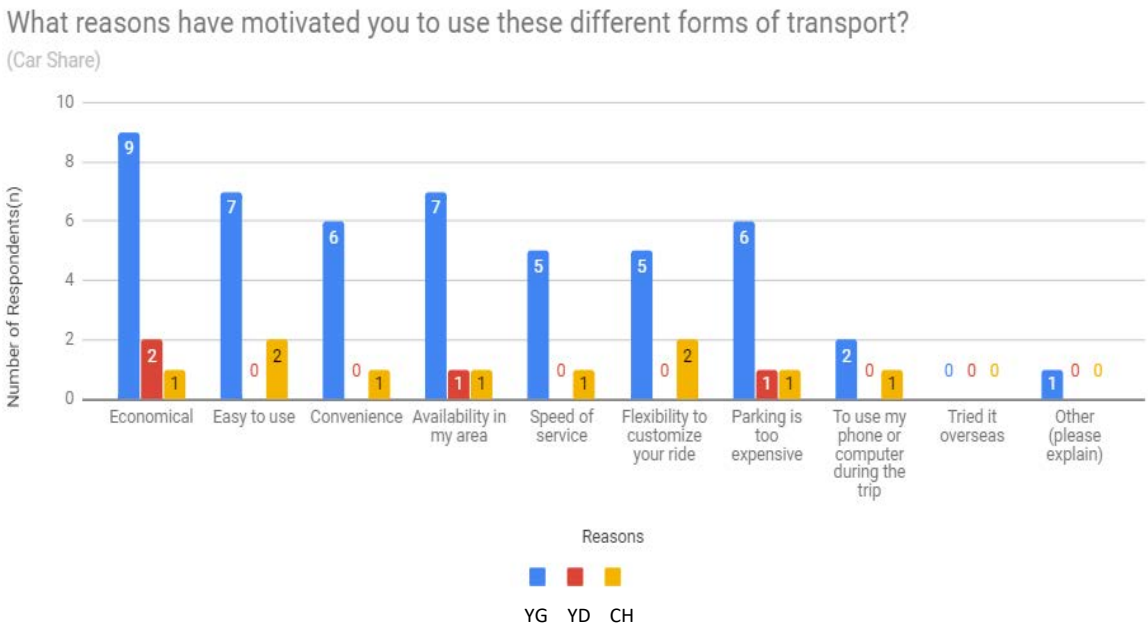

Figure 29: Yoogo Share (YG) / Yourdrive (YD) / Cityhop (CH) service success according to the data set

For Ride Share, SAVY was the first option, but it had a limited amount of responses. The top three reasons behind the usage of these services were “economical” (3 times), “convenience” (2 times) and “parking is too expensive” (2 times) (Figure 30). Driving Miss Daisy was the second option under ride share, this had a limited amount of responses. The top three reasons behind the usage of this services were “availability in my area” (4 times), “easy to use” (2 times) and “convenience” (2 times). Airport Shuttle was the third option under ride share. The top three reasons behind the usage of these services were “economical” (49 times), “easy to use” (32 times) and “convenience” (30 times). GOVbus was the final service under ride share, this had a limited amount of responses. The top two reasons for the usage of these services were “convenience” (3 times) and “economical” (2 times).

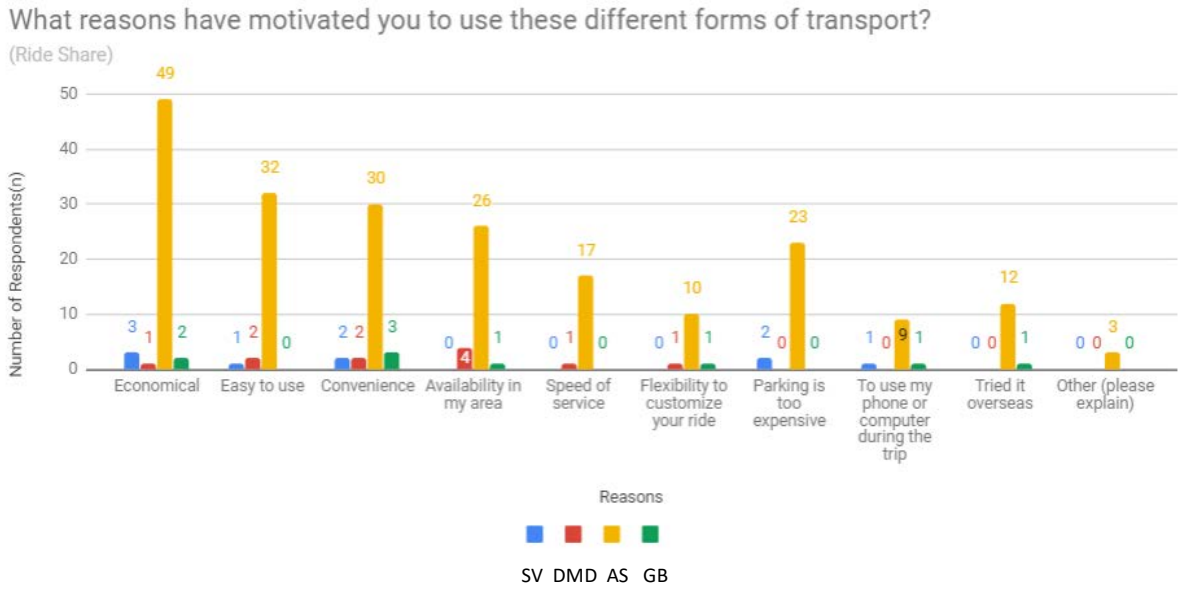

Figure 30: SAVY (SV) vs Driving Miss Daisy (DMD) vs Airport Shuttle (AS) vs GOVBus (GB) service success according to the data set

For ridesourcing/ ride-hailing or ride-splitting, Zoomy was the first option and this had very limited responses. The top two reasons were “economical” (5 times) and “easy to use” (3 times). Ola was the second option. The top three reasons behind the usage of these services were “economical” (10 times), “easy to use” (9 times) and “speed of service” (8 times). Finally, Uber was the last option under ridesourcing/ ride-hailing or ride-splitting. The top three reasons behind the usage of these services were “economical” (42 times), “convenience” (42 times) and “availability in my area” (40 times) (Figure 31).

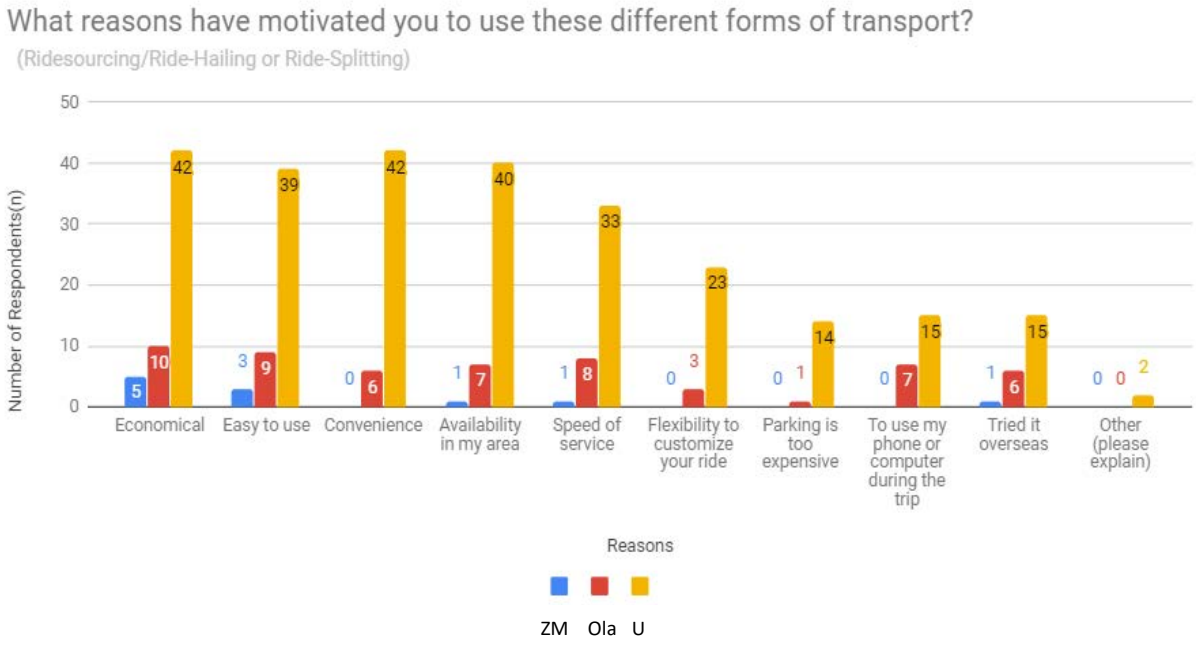

Figure 31: Zoomy (ZM) / Ola / Uber (U) service success according to the data set

4.4.7 Factors stopping the use of different Shared Mobility Systems in Christchurch

In the following section, I will highlight the top five factors stopping the respondents from using different shared mobility systems. This includes bike share, car share, ride share, ridesourcing/ ride-hailing or ride-splitting, and Lime-S. A point to note is not everyone had to choose an answer to proceed. This means that not all the numbers will add up to 103.

The topmost factor selected for preventing the use of shared mobility is “not enough information” (101 times). The second highest factor was “it is not safe” (98 times). The third highest factor was “limited privacy (e.g. I don't like the idea to share a ride)” (94

times). The fourth highest factor was “don't use a credit card for transport bookings” (87 times). The fifth highest factor was “not available in your area” (81 times) (see Figure 32).

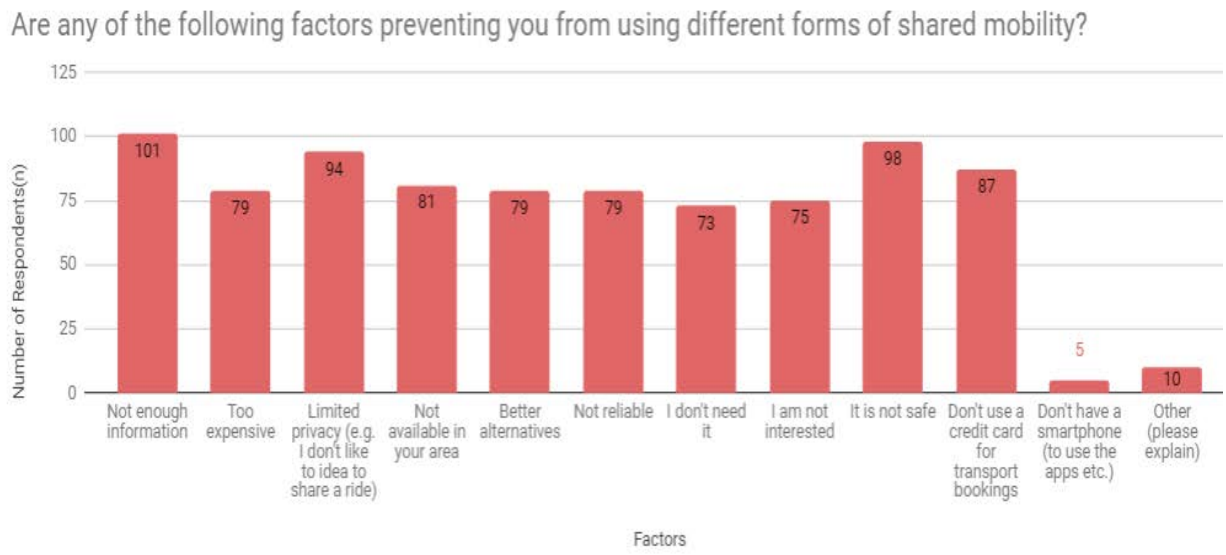

Figure 32: Key factors preventing the usage of the different shared mobility systems.

These are the primary results from my research in the next chapter I will discuss the implications of my findings.

Chapter 5: Discussion

5.1 Summary of Findings and Structure

My first research aim is to identify what is affecting low public transport (**PT**) usage and what might change in the future in Christchurch. My second aim is to identify the perceptions towards shared mobility and the potential of shared mobility to support PT.

For my first research aim, my results suggest that low PT usage is affected by a range of factors. Policy-makers and operators identified low population density and convenience of cars compared to PT as critical factors. Policymakers also identified car dependency as a factor. A large number of the surveyed community had neutral feelings about using PT and used it only if it was convenient when compared to other forms of transport. Policymakers said that income was another factor: people with limited money may find PT harder to access. The survey also found that high fares deterred PT usage. Greater spatial distance from the central city was a factor for low PT usage: policymakers stated that delivering PT was more difficult for remote areas. Policymakers and the survey both identified low frequency and availability of PT as contributing to low PT usage.

The results also identify some factors that could improve PT usage. Policymakers and survey respondents said cheaper fares would improve PT usage. Having services available closer to home was another factor that both identified. Policymakers and shared mobility operators highlighted that in the future, technology would change the way PT works in Christchurch. An interconnected single Mobility as a Service (**MaaS**) system is planned for the different cities in New Zealand. This will be an on-demand service that could improve PT usage.

For the second aim, my key research findings where that policymaker believed that shared mobility is still a new field and extensive research needs to happen to understand their feasibility. However, policymakers were open to shared mobility systems co-existing and supporting PT in the future especially in areas where PT may be hard to reach. Policymakers also thought that shared mobility systems would be better used if integrated with the MaaS system. Operators believed shared mobility has a lot of potential to grow in Christchurch and even support PT by providing for the

harder to reach corridors. However, getting people to try the services is one of the biggest challenges they face. Currently, they are focusing on improving awareness of their brands to help improve usage. They have also highlighted that there is a lot to learn about how people use their system.

The survey revealed that people who use shared mobility systems are drawn to it because of a range of factors. The top reasons were that they are economical, easy to use, and a convenient form of transport. Availability of the service for locals was also a critical factor. However, the lack of availability was a disincentive for those who said they did not use shared mobility systems. The majority were reluctant to use shared mobility services because of a lack of information about these services. Privacy and safety concerns were other reasons for not using these services, and the inability to use credit cards to pay was a further reason.

In the sections below, I have elaborated on the above findings by answering each of my research questions. I have then discussed research limitations, the implications of my research, the contribution this has made to the existing literature, and recommendations for future research.

5.2 Research Aim One: Identify what is affecting low PT usage in Christchurch and what might change in the future

5.2.1 Factors affecting transport and PT in Christchurch

Policymakers in Christchurch agree that PT usage is a lot different when compared to other cities around the world. They agree that the city is spread out and bigger cities like Auckland and Sydney have a bigger population and better PT coverage which leads to more usage. This is correct when looking at the total number of PT boarding by region. In Auckland and Wellington, PT patronage was much higher than in Christchurch (MOT, 2017).

5.2.1.1 Accessibility

The local policymakers agree that better access PT system is key for improving the PT system, especially in areas where it has been difficult for PT to be extended. Poor access to PT leads to poor usage and more car dependency. This is consistent with the findings of Saroli (2015) and Borg and Ihlström (2019), who highlight that accessibility to PT can be a major issue in rural or low populated areas which leads to car usage.

Respondents to the survey were asked what would make them consider using PT more often (Figure 13). The top response was that the PT service should be “closer to home”. Once again research from Borg and Ihlström (2019) Imran, Yin and Pearce (2015) show consistency with these results.

5.2.1.2 Frequency and Availability

Policymakers highlighted that improved frequency of services and better “peak time offset” (that is, having more services available during peak time) are essential to help improve PT. This is consistent with Imran, Yin and Pearce (2015) who found that PT attractiveness drops with low frequency of services.

From the online survey, 47 respondents who stated that they “never” used buses (PT), (Figure 10 and 12) stated that “current bus routes don’t suit me” (an issue of availability), “services aren’t frequent” (a concern about frequency). The same lot of respondents were asked what would make them consider using PT more often (Figure 13). One of the top three prominent response was “higher frequency of service” (more buses and bus routes). This is consistent with research from Borg and Ihlström (2019) who found low frequency and poor availability of PT led to lower usage rates. Similarly, Taylor and Fink (2013) stated that improved frequency leads to lower travel times. Imran, Yin and Pearce (2015) also found similar results in Auckland.

5.2.1.3 Convenience and Time

Policymakers also believe that “convenience” and “bring down time” for travel are critical factors affecting PT usage and that convenience must improve to attract more users to PT. This is consistent with the research from ITF and OCED (2014) that found that convenience plays a major role in attracting users to PT.

Form the online survey, 47 respondents who answered that they “never” used buses (PT), (Figure 10 and 12) stated that one reason was that “service is too slow” – which can be interpreted as an issue of convenience and time. This is consistent with literature by Stradling, Meadows & Beatty (2000) who found time to be a major factor in attracting users to PT.

5.2.1.4 Poor Perception of PT

Policymakers believe that maybe PT is not valued due to poor perceptions on “convenience”, “time”, “availability” and so on. This is consistent with research from Imran, Yin and Pearce (2015) who found some similar result in Auckland.

Further, there was a discrepancy between the policymakers' perception and the survey results. For PT use (Figure 11) the Christchurch community data set showed positives sentiments with a total of 55% from saying "mostly positive" and "positive" about using PT while a total of 45% showed they had either "neutral" and "negative" feelings about PT usage in Christchurch.

However, it is possible that the survey results were biased towards "mostly positive" and "positive" responses because the survey was hosted by on the Metro Canterbury page, which is the local bus service operator. People who visit the webpage are more likely to be existing PT users, who might have a more favourable opinion of PT than people who either do not use PT or have stopped using PT because of their poor experience.

5.2.1.5 Population Density

Policymakers believe that population density is a major factor affecting PT usage. Local policymakers agreed that Christchurch's medium to a low-density city is a challenge for PT. They agreed that the greater density the higher population which generally leads to more usage. This finding is backed up by Denne and Wright (2016) and ECAN (2018). Cooke and Behrens (2016) also found that the viability of PT is affected by population density.

5.2.1.6 Income

Income affects PT usage according to policymakers. This is consistent with research from Imran, Yin and Pearce (2015) who found that affordability affects PT usage.

From the online survey, the 47 respondents who stated that they "never" used buses were asked what would make them consider using PT more often (Figure 10 and 12). One of the top three factors identified as "cheaper cost" (Figure 13). A study from the CCC (2017) also found that respondents to their survey identified a reduction in fares as a factor that would encourage them to use PT more.

5.2.1.7 Car Dependency

Private motor vehicles usage is a major factor affecting PT usage according to policymakers. This is consistent with research from Saroli (2015) and Borg and Ihlström (2019), who found car dependency in rural or low populated areas to be playing a part in reducing PT usage.

5.2.1.8 Cost-effectiveness

Policymakers believe that using the PT system in Christchurch is cost-effective for long trips when compared to Auckland or Wellington but not for short trips. This should suggest that PT should be cost-effective for commuters from satellite towns and suburbs such as Rolleston, Pegasus and West Melton. However, that does not appear to have been the case. A possible explanation for this is that there are limited services and the frequency of service does not suit the times for the commuters so that any advantage from cost-effectiveness is offset by the inconvenience.

5.2.1.9 Distance from Central Business District (CBD)

Policymakers have stated that people living in "close proximity" to the Central Business District helps improve deliver a PT service. This is also consistent with findings by ECAN (2018) who claim that PT performs better in a compact environment which helps direct high-frequency services, which help connect to commercial, retail and recreational activity sites more easily.

Christchurch is facing the opposite scenario because of the suburban sprawl identified above. Policymakers have found it difficult to deliver services at greater distances away from Christchurch City.

5.2.1.10 Other factors affecting PT usage

For daily transport usage patterns for all journeys, walking was the highest frequency used for "most days" (Figure 7). At first glance, this is a surprising result when compared with Census data of 2013. On Census day 84% of people commuted to work day with either a car, van or truck and from that, 64.1% of people used private cars as their main mode of transport (StatsNZ, 2013). My result also appears to be inconsistent with the household travel survey from the Ministry of Transport (2015) about mode share of travel times between 2011 and 2014. Once again walking only accounts for 13%, when compared to a private car as a driver which is 52%.

However, the likely reason for this discrepancy is that my question did not limit the answer to "main mode" of the journey, and so included "any mode". Most people walk at least some steps every day from Point A to Point B, notwithstanding the fact that their "main mode" of transport might be a car. Therefore, it is likely that walking was the highest frequency mode for "most days" when any modes are considered but not the highest frequency for "main mode".

Another explanation of walking dominating “most days” could be that the community captured in the data set are biased towards PT, as explained in my methodology in Chapter 3. PT users are more likely to be walking to access the PT system. This is consistent with the Ministry of Transport (2015) research which concludes that people who use PT are likely to walk more often. However, the bias towards PT is unlikely to cause such a major difference between the Census 2013 results and my results, which makes the first explanation more likely.

Car usage was the most used mode on a timescale of “3 – 4 times per week” (Figure 8) and “1 – 2 times per week” (Figure 9). This result is expected in light of the 2013 Census’s findings for Christchurch (StatsNZ, 2013). By contrast, the second highest and highest recorded usage for the bus was for the time scales “once a month” and “never” respectively (Figures 9 and 10). This is not conclusive evidence that PT is used rarely in Christchurch because bus usage is one of the top three most-used modes of transport for the timescales “3-4 times per week” and “1-2 times per week”.

5.2.2 Future of PT

The local policymakers state that to improve the future of PT the regional transport goals need to be met (see Appendix I for regional transport goals). Other highlighted factors were the growth in frequency, improved convenience for users, understanding the customers’ travel needs, improved journey times and better network coverage especially to allow more access to people who do not currently have access. The policymakers believe that current plans will help them meet short-term goals but limited resources and restrictions on resources would “hinder” them. Currently, it is a long term vision with a short term plan.

Policymakers state that they see “MaaS” playing a crucial role in the future of PT and shared mobility services will have a role either inside or alongside PT systems in “smaller corridors”. They expect technology to transform “PT structure”. This is consistent with Meng et al., (2018) who believe that shared mobility will play a larger role in “MaaS”.

5.3 Research Aim Two: Identify the perceptions towards shared mobility and discuss the potential of shared mobility

5.3.1 Perceptions towards Shared Mobility in Christchurch

Policymakers identified that shared mobility is a system which allows users to “rent or buy” to get from point A to B through shared transportation. Policymakers confirmed that in Christchurch shared mobility has been considered. Bike share systems were in place and were supported by the regional council. Carpooling and other hybrid forms of demand response transports are currently operating or are being trialled.

The policymakers’ response is consistent with academic research from the likes of Cohen and Shaheen, (2016) and Shaheen, Cohen and Zohdy (2016) who all highlight that shared mobility falls under the category of shared use of transport. An inconsistency between the results and the literature is that policymakers think that “buying” is part of the process of shared mobility systems. Yet Vine and Polak (2015) claim that when using shared mobility individuals never actually buy but rather pay a fare at a fixed price for their usage. One explanation for this could be that policymakers believe that after using Lime-S individuals have bought e-scooters which would explain why they think shared mobility involves buying.

Shared mobility operators had defined the shared mobility system as a transport system that enables more than one person to travel in the same transport. They also described it as shifting from “ownership” to “a shared economy”. This understanding, which focuses on sharing rather than buying, is more consistent with academic research from Cohen and Shaheen, (2016) and Shaheen, Cohen and Zohdy (2016).

5.3.2 Role of Population Density for Shared Mobility

One of the most important perceptions in the interviews was the effect of population density on shared mobility usage. Shared mobility operators believe that low population density probably hinders shared mobility because there are fewer people to use the systems. Operators believed that higher population density areas cater for more vehicles to be available and demand is a lot higher. A larger population would also enhance the potential for shared mobility. This is backed by research from Cohen and Shaheen (2016), who state that shared mobility tends to thrive in higher density urban environments.

Interestingly, operators stated that they thought shared mobility has potential in areas where PT is not effective, including low-density areas. It was not clear from the interviews how they thought that the challenge posed by low population density could be overcome in these areas. However, there is some support for this proposition:

However, they also believe that shared mobility can adapt better to different areas of the city with varying population densities where PT cannot operate effectively. Cohen and Shaheen (2016) state that shared mobility has started attracting usage in medium to low-density areas. A point for further research would be why shared mobility operators believe that shared mobility can function better in certain low-density areas where PT is not effective.

5.3.3 Barriers and Challenges for Shared Mobility

While shared mobility has a lot of potential there are also many barriers which are holding it back. The results from the survey (Figure 32) identified the following as the top five barriers and challenges:

1. “not enough information”
2. “it is not safe”
3. “limited privacy”
4. “don't use a credit card for transport bookings”
5. “not available in your area”.

I have discussed each of these below. I note that these responses relate to shared mobility as a whole and do not distinguish between the different forms of shared mobility that I have studied. However, I have identified where responses to other survey questions reveal that a particular barrier is less relevant for a particular form of shared mobility.

5.3.3.1 Not enough information

The majority of the 103 respondents (61%) had no idea what a shared mobility system was and only 39% had heard of the term shared mobility (Figure 14). The interviews give some insight into the reason for the lack of awareness. Policymakers said that shared mobility is a “very new” concept and they are “learning every day”. This is consistent with the answer from the SUMC (2015), who have also stated the shared mobility is a new and evolving system.

Despite not having heard of “shared mobility” as a concept, respondents were most familiar with at least some individual shared mobility systems. Ninety-one percent had heard of car sharing and 85% had heard of ride sharing. Sixty-three percent had heard of bike sharing and e-scooter respectively. Only twenty-four percent had heard of ride sourcing/hailing and splitting (Figure 15).

The shared mobility operators state that the main challenge for shared mobility is to get people “on board”, in other words trying to get people to try the service. This is consistent with research from MOT (n.d) which believe that the New Zealand public will not embrace shared transportation.

Another barrier that operators identified is that they have to set up shared mobility from scratch, which means there has been little time for the brand to grow. The local operators also confirm that to overcome these challenges they are improving their brand awareness. In the future with time and money, they plan to improve their current systems and improve the overall mindset of the end users and discourage them to use a second car.

5.3.3.2 Safety Concerns

Safety concern was the second-most frequent factor identified in the survey as a barrier to the use of shared mobility. I do not have data regarding the level of safety concern by type of shared mobility. However, it is possible to hypothesise about some of the reasons.

Accidents are likely to be the biggest safety concern for bike share and e-scooters because of the “fragility” of the rider. There is no external “shell” protecting the rider from other road users and hazards, unlike with a car or a bus.

Meanwhile, ride share users may have concerns around sharing their rides with strangers while ride sourcing/ hailing or ride splitting users may have safety concerns around their drivers. Research from Atkins (1990) has highlighted the in transport personal security is right at the forefront. Chaudhry et al., (2018) and MERGE Greenwich (2018) highlighted that certain forms of shared mobility like ride share or ride sourcing services like, Uber, does pose dangers for a user as there is uncertainty about drivers or sharing a car with strangers which could cause social discomfort.

5.3.3.3 Privacy

Limited privacy was the third most-common barrier to shared mobility. While I do not have individual data from the separate shared mobility system, I can speculate why there may be privacy concerns for certain systems. For example, ride sourcing or ride sharing users may have a concern around personal space, especially when sharing a ride with strangers. However, privacy is unlikely to be a concern for bike share or e-scooter sharing because riders use them on an individual basis.

There is limited literature on privacy concerns as a barrier to shared mobility. However, there is likely to be some overlap with the safety concerns. As noted above, Chaudhry et al (2018) and MERGE Greenwich (2018) highlighted the social discomfort about driving with or having to share a car with strangers.

5.3.3.4 Reluctance to use a credit card to book

87 users identified an unwillingness to book by credit card as a barrier to using shared mobility. This was the fourth highest factor. This is an unexpected find because I saw no research that connects reluctance to use credit cards to book.

It is possible that the reluctance is connected to security concerns, which in turn could be connected to the fact that shared mobility is not yet a widely known or recognised system. Shared mobility systems might not be commanding the same level of trust that websites such as “TradeMe” or “Amazon” command because people are unfamiliar with these systems and may fear scams.

5.3.3.5 Availability

The survey found that the unavailability of shared mobility systems in the locality where a respondent lives was a barrier to using shared mobility. The individual break-down of unavailability as a barrier shows differences between the different modes of shared mobility.

5.3.3.5 (a) Bike share and E-scooter share

Lime-S had the highest response rate for “available” at 71%. Spark Bikes and Onzo had the highest “I don’t know” if these services are available (Figure 17).

The lack of awareness of Onzo is understandable because it is a Wellington service and therefore might not be familiar with most Christchurch residents. There could be more than one reason for the lack of awareness of Spark Bikes. The first is that Spark

Bikes no longer operates in Christchurch. Further, it is possible that bike-sharing is generally low-profile and targeted for niche users: Circella et al. (2018) found that in California, over half the respondents were unaware if bike sharing service was available for use in their area.

5.3.3.5 (b) Car share

Yoogo Share is the most popular, with the most number of responses for “available” (39%). By contrast, 76% said that they “did not know” if Yourdrive was available (Figure 20). This was surprising because Yourdrive operates in Christchurch.

A possible reason why Yourdrive is less known could be better awareness about Yoogo Share. Yoogo Share has an electrical car fleet whereas Yourdrive has standard fuel cars. The environment-friendly image of Yoogo Share might have resulted in more favourable publicity than Yourdrive.

Further, the fact that Christchurch is a largely car-dependent city could mean that many people might not have investigated car-sharing options. Circella et al., (2018) found that in California, most respondents were not sure if car sharing was available to them. Whether this is attributable to car-dependency is unclear.

5.3.3.5 (c) Ride share

Airport Shuttle had the highest percentage of responses registering “available” at 79%. Driving Miss Daisy was second at 47% and Greencab came third at 38%. The familiarity with Airport Shuttle is likely to be due to the fact that most people have travelled to the Airport and would be aware that this service exists.

SAVY and GOVBus had the highest number of collected responses saying “I don’t know” at 83% and 85% respectively. This is an expected result because SAVY operates in Queenstown, not Christchurch, while GOVBus is aimed at Governors Bay residents to connect to PT. People outside Governors Bay and Lyttelton are unlikely to know about this service.

5.3.3.5 (d) Ridesourcing / Ride hailing and Ride splitting

Uber is the most available at 89% for collected responses (Figure 26). This is consistent with research from Circella et al., (2018), as respondents from urban, suburban and rural areas of California stated that services like Uber and Lyft were available for them to use.

“I don’t know” responses dominate for Ola and Zoomy at 58% and 77% respectively. This is consistent with the fact that Ola and Zoomy are new to Christchurch (establishing only in November 2018) and therefore many people will not know if the services are available where they live.

5.3.4 Usage, Positives and Perceptions of Shared Mobility

5.3.4.1 Bike Share and E-scooter share

Lime-S had the highest number of users to have “used the system in the past” (16%) or who were “current member” at (26%) when compared to the now extinct Spark Bikes (Figure 16). Onzo which is a Wellington-based bike sharing system, not surprisingly recorded the highest number of respondents saying that they had never used the service. The result that bike sharing is not being used by the majority of the respondents is consistent with research from Circella et al., (2018), who found that in California most respondents had never used the service and few had only of the heard service.

The top three reasons for using Spark Bikes were that it was “economical”, “easy to use” and convenient (Figure 28). This is consistent with Ricci (2015) who found that convenience plays a role in attracting users to bike share, and Berger (2018) who found in China that users were attracted to bike share because of how easy it is to use and how low cost it is compared to other forms of transport.

For e-scooter, the top three reasons for using Lime-S were that it is “easy to use”, convenient and available in the respondent’s locality. Significantly more respondents used Lime-S than other forms of e-scooters, which is expected as Lime-S is currently very popular in Christchurch.

The survey showed mixed feelings about the use of bike share and e-scooter if the services were available: 39.8% said that they would “maybe” use these services (Figure 18). This suggests that the future growth of e-scooter is uncertain.

5.3.4.2 Car Share

Yoogo Share had the highest percentage of responses for people “having used the system in the past” (6%) or being “current member” (8%) (Figure 19). The fact that Yoogo Share is the most-used is expected as it is one of the more popular brands in Christchurch. It has also received favourable publicity because of its fleet of electric cars. However, car-share usage was still relatively low. This is consistent with the

findings of Circella et al., (2018) and Drápela (2015), they both found that car sharing services have been heard of by the majority of respondents yet they had never actually used the system.

The top three reasons for using Yoogo Share services were that it is “economical”, “easy to use” and available in the respondent's locality. Both Yourdrive and Cityhop had very small responses that are not significant enough for comparison (Figure 29) so I am not going to consider their results for this discussion. Research from Giesel and Nobis (2016) was consistent with one of the findings from Yoogo Share, namely that the costs of owning a private car were high and car sharing was sufficient. For some Christchurch residents, owning a private car could be costly which would make car sharing more economical. Yakovlev and Otto (2018) found the ease of securing a vehicle for use plays a role in more car sharing, which is consistent with my research which highlights that car sharing is “easy to use”. Further research from Ballús-Armet et al. (2014) found availability as a key reason for attracting users to car sharing in the USA. This is also consistent with my research as “availability in my area” from the community was one of the main attractions to using the system.

Finally, perception towards future use of car share was more negative than positive: 38.8% said “no” to using car share if it were available while only 29.1% said, “yes” (Figure 21). It is possible that Christchurch’s relatively high car ownership makes car service as a useful option for a large number of respondents. This would be consistent with the fact that the majority had never used the car share system.

5.3.4.3 Ride Share

Airport Shuttle service demonstrated the highest number of users to have “used the system in the past” (75%) or as a “current member” at (3%) (Figure 22). Greencab was the next closest at 31% having “used the system in the past”. Driving Miss Daisy was next and their service is aimed at the elderly and generally aim to provide for total mobility schemes in New Zealand. There is a possibility that the usage data for Driving Miss Daisy was lower than is actually the case because elderly people are generally less likely to use social media, where my survey was hosted.

Most respondents had “never used” most ride share services except for Airport Shuttle. This is backed by research from Circella et al., (2018), as in California ride sharing services were heard of but mostly never used by respondents.

The top three reasons for using Airport Shuttle (Figure 30) were that it is “economical”, “easy to use” and convenient. However, it is difficult to make inferences about ride share from the survey results. SAVY, Driving Miss Daisy and GOVBus all had very limited responses so their answers are not significant for comparison or conclusive. SAVY was one of my case studies for my research the limited amount of data meant that I cannot compare it with Airport Shuttle. Airport Shuttle is not directly a solely based ride sharing experience as it offers various different services. It is possible that respondents who used Airport Shuttle had used it for one of the other services as opposed to ride sharing. This means that the findings for ride sharing are inconclusive.

Finally, the attitudes of the Christchurch community showed mixed feelings when asked whether they would use these ride-sharing services if they were available to them. The majority of the community said “maybe” 44%, while 29% said “yes” and 18 said “no” (Figure 24). There is a sense of uncertainty once again in the Christchurch community. Again, it is possible that car-dependency in Christchurch makes ride share options appear irrelevant to many respondents.

5.3.4.4 Ridesourcing/ Ride-Hailing or Ride-Splitting

Uber without surprise had the highest number of collected responses to “have used the system in the past” (30%) or a “current member” at (31%) (Figure 25). Yet surprisingly Ola and Zoomy both had a very low amount of users respectively to “have used the system in the past” or a “current member” One explanation for this could be that both Ola and Zoomy launched in Christchurch in early November at the end of 2018. Overall “never used” was the highest trending bar line for both of these services.

The top three reasons for Uber usage were that it is “economical”, convenient and available in the respondent’s locality (Figure 31). For Ola, the top three reasons were “economical”, “easy to use” and “speed of service”. Zoomy had a very limited response and is not significant for comparison.

Uber being popular amongst the Christchurch community is an expected result. Carranza et al., (2016) stated that ride sourcing services are economical as it helps saves the cost of not owning a car. This is consistent with the top reason for using Uber according to my survey. Uber (n.d) claimed that the ability to easily access its users has made ridesharing popular when compared to traditional forms of PT. This

is consistent with my research findings as many of the ridesourcing/ride-hailing or ride-splitting services have highlighted “convenience” as a key reason for using the system.

Nielsen et al. (2015) found that a lack of availability was one of the factors which stopped people from using a shared mobility service like ride sharing and ride sourcing. This is consistent with my research findings in the sense that “availability in my area” was one of the factors which encouraged users in the Christchurch community to use shared mobility systems.

The respondents showed largely positive feelings when asked whether they would use these ridesourcing/ride-hailing or ride-splitting services if they were available to them: 42% said “yes” while 36% said, “maybe” and 22% said “no” (Figure 27). This is considerably more favourable when compared with other forms of shared mobility systems above like bike-share, car-share and ride-share. It is possible that the popularity of Uber and anecdotal stories or personal experience of how convenient it is makes respondents favourably disposed towards using Uber.

5.3.5 Potential of Shared Mobility in Christchurch

Policymakers believe that “MaaS” will play a crucial role in the future of PT. Operators state that shared transport could play a part under an integrated “MaaS” service. This claim is further back by research from Meng et al., (2018) which highlights that shared mobility could play a critical role in setting up the “MaaS” service. Research from Velaga et al., (2012) and Daniels and Mulley (2012) both state that on-demand or flexible transport services are something which should be considered for rural areas or low-density areas in the future.

Policymakers believe that shared mobility can help solve environmental problems. For example, Yoogo Share uses pure electrical vehicles which means zero C02 emissions. However, they see that certain forms of shared mobility can lead to an increase in car congestion and hence environmental problems. This is consistent with the research from Schaller (2018) which stated that Uber and Lyft usage increased more cars on the roads in the USA which lead to road congestion. This also backed up by the San Francisco County Transportation Authority (2018) report which stated that hours spent on a typical weekday was increased due to ride-hailing services.

The Shared Mobility operators state that currently, their systems help bridge the gap between taxis and buses and are part of the mobility jigsaw puzzle. They aim to move

people more efficiently. This is consistent with one of the findings from Laporte et al. (2015) that the rising popularity of these systems is because they help increase efficiency for an end user.

Operators also state that they have lower fares than PT. They believe that the systems could be a lot bigger and with growing popularity and opportunity exists especially when one looks at car-related costs in New Zealand when compared to what car sharing offers. This is supported by Carranza et al. (2016) who claim that ridesourcing services are valued by users because they help save purchasing, maintaining and operating cost from owning a private vehicle.

The operators believe that the future is definitely bright for Christchurch especially after Lime-S's (e-scooter shares) arrival which has improved usage and awareness of these systems. The operators are aiming to be working with the local, regional councils and community to better serve their needs.

They believe that a better-integrated service with the current PT system will allow them to offer the service far better. This is backed up by ECAN (2018) who claim that shared transportation in an interconnected transport system could help them reach their scheduled services in harder-to-reach areas like areas with lower population density. Further research from Ohnemus and Perl (2016) state that shared mobility could work in a wider connected transport landscape with some combined app system, especially in low-density areas. Shared mobility operators believe their services will have a role alongside PT systems in "smaller corridors".

It must also be noted that they believe that autonomous vehicles "will play a major role". This is also consistent with Cohen and Shaheen (2016) and Ohnemus and Perl (2016), all authors believe that autonomous vehicles' popularity is growing and Shared Autonomous Vehicles (SAV's) could play a part inside the current shared mobility system.

5.4 Limitations

Due to the fast-paced nature of shared mobility, I have had to adapt my case study examples throughout the year as new companies have come and gone. This has been one of the major challenges in researching this field. For example, I had initially planned to look at Spark Bikes and SAVY. However, both Spark Bikes and SAVY trials

have ended during the time of this thesis and the services have been taken offline. While I still continued to use these examples because bike-sharing and ride-sharing services have been widely successful around the world, it potentially reduced the current relevance of some of my results. There is a possibility that the local population may have forgotten why and how they used these services. Further, finding the correct local operators to interview and understand their system became difficult as they may have moved away from Christchurch.

Another major limitation I faced when conducting the interviews with the shared mobility operators was their availability. I wanted to interview all four of the case study examples I had chosen for my research. The changing nature of the field meant that there was a major uncertainty whether some of these systems will continue to play a part in Christchurch in the near future. This meant that no matter how I tried to conduct interviews with some shared mobility operators I faced major delays in response or failed to capture their interest. I could have interviewed new companies on the block but I avoided it because I wanted to interview shared mobility companies which have been established in Christchurch or the South Island for some time. A new company which is still learning how their systems are progressing in a new city could give a lot of uncertain answers. Having captured a bigger sample of shared mobility operators would probably eliminate any bias but having only completed two sets of interviews meant that there may be a bit of bias in the answers. If I had another year for my research I could have more time to capture a much wider audience for my online survey.

Having the survey available for online social media pages of PT providers means that I may have captured a sense of bias towards the PT side of the Christchurch community. Future research could try sending out the survey to all the various shared mobility systems currently running in Christchurch. Other populations like specific studies on students should also be considered. By sending out the online survey to university students an opportunity exists to see how the younger generation use general transport and shared transport. Overall a bigger sample size would have really allowed me to do a lot more statistical analysis which would have eliminated bias.

5.5 Recommendations for future research

There are areas where future research needs to be established to deepen our knowledge on this field. Statements that remain unanswered and require more research include:

1. the different potentials for shared mobility systems across different parts of the city especially in a medium to low-density city.
2. why shared mobility operators believe that shared mobility can function better in certain low-density areas where PT is not effective.
3. how safety and privacy concerns affect the usage of individual shared mobility systems.
4. whether walking has increased from the last census, in which case there might be more potential for the expansion of PT and certain shared mobility systems like bike share and car share where walking will be required to access the systems.
5. how targeted populations such as students or elderly are using general transport and shared transport.
6. how E-Scooter usage in Christchurch is affecting PT.
7. how technological advances are affecting transport in New Zealand and especially how a MaaS system could connect users through an app-based on-demand service.

A larger sample size for the interviewees and survey respondents, including an option for hosting the survey on a neutral website that will not be biased towards either PT users or shared mobility operators, would be beneficial.

5.6 Research Contributions

For Aim One, my research findings were highly consistent with existing literature. It contributes to the field by confirming that the findings in other medium-to-low density cities regarding PT also applied in Christchurch.

For Aim Two, my research revealed some points of interest beyond confirming the existing literature. Limited work has been done on how shared mobility works in a

smaller city (Shiftan & Kamargianni, 2018). The findings from shared mobility operators confirmed that in a medium to a low-density city of Christchurch they believe shared mobility can help bridge the gap left by PT. The findings of my research suggest that shared mobility can help improve convenience from end users.

Laporte et al., (2015) believed that shared mobility's popularity is down to improved convenience for the end user. This is also now confirmed for a medium to a low-density city. The findings showed that people who had used shared mobility had highlighted that in a medium to a low-density city "economical", "easy to use", "convenience" and "availability in my area" where the most common reasons to use shared mobility. Research from cities which are not of similar population density to Christchurch reported similar findings for the popularity behind using these systems (Ricci, 2015; Berger, 2018; Giesel & Nobis, 2016; Ballús-Armet et al., 2014; Carranza et al., 2016 and many others).

My findings have also stated that in a city of Christchurch, the community are sceptical about the systems because there is limited information available about the systems. Other top reasons for not using the systems are: they feel these systems are not safe, limited privacy and do not use their credit cards for booking these systems. Research from Chaudhry et al., (2018) and MERGE Greenwich (2018) highlighted that some shared mobility systems like ride share are probably not safe for users. My findings have not only confirmed similarities from Chaudhry et al and MERGE Greenwich research but members of the community in Christchurch from a smaller city has also shown consistency with current research.

While I did not use e-scooter sharing as one the four primary examples my findings did confirm that amongst the community the popularity of its usage is increasing in Christchurch. I think future research into how this shared mobility system is behaving could be useful in understanding how it may help support or run beside PT.

5.7 Research Implications

The research implications I will highlight by my research aims.

5.7.1. Implications for Aim One: Identify what is affecting low PT usage and what might change in the future in Christchurch.

Population density, accessibility, car dependency, income, the frequency of service and availability, convenience, high fares are all factors which were highlighted by the local policymakers in the Christchurch community. Numerous academic research has also found similar results (ITF and OCED, 2014; Cooke and Behrens, 2016; Taylor and Fink, 2013; Stradling, Meadows & Beatty, 2000; Imran, Yin and Pearce, 2015; ECAN, 2018 and others). Future research in cities of similar characteristics to Christchurch, which is suffering from low PT patronage, could look to identify if similar results are found. This would help highlight and justify the issues to local policymaker's who could then look for appropriate provisions to PT to help improve patronage.

5.7.2 Implications for Aim Two: Identify the perceptions towards shared mobility and discuss the potential of shared mobility

The Christchurch community revealed that shared mobility systems are popular because they are economical to use, easy to use, are convenient and are available in their local area. However, the majority of services were minimally used and this leads to a lot of uncertainty about information surrounding the systems and safety. This means that there have to be deeper future studies which look at how shared mobility behaves differently across a different section of the city. Shiftan & Kamargianni (2018) observed similarly that shared mobility behaves differently with different populations. The mixed success in a medium to a low-density city like Christchurch shows that certain forms of shared mobility are popular however future research needs to find why this is the case. This information can then be very useful for local policymakers as they can identify and analyse pockets of the city where shared mobility is used more predominantly. This information can then be used to incorporate into their wider policy and plans to provide alternative options to their local community.

The data collected from the Christchurch community showed that for "most days" walking is a mode of transport. It is possible that this was due to a misunderstanding of the question as relating to any mode of transport rather than the main mode of transport. However, it would be useful to see if walking has increased from the last Census. An increase in walking could be potentially useful as shared mobility systems like bike-share, which require the user to walk a short distance to access the system.

If walking remains low, having shared mobility systems like bike-share near current bus networks could help increase PT usage. Shaheen and Chan (2016) believe that bike sharing can help first and last mile solutions and can help increase PT usage. Kaufman et al., (2015) found that bike sharing increased PT usage due to a small amount of walking required from subway stations and bike stations yet Shaheen et al., (2011) stated that bike share had mixed effects on PT usage.

Policymakers and shared mobility operators believe MaaS will play a critical role to shape up the future of PT especially in New Zealand. Research from Meng et al., (2018); ECAN (2018) have also backed this claim. Policymakers and shared mobility operators believe that shared mobility may play a role inside the MaaS systems whether this is through SAV's or supporting harder to reach corridors. I think future research needs to identify what role technology will play in adapting to PT but also how the MaaS system may play a role in connecting future users to on-demand transport.

Chapter 6: Conclusion

My research question was what factors are influencing low public transport usage in Christchurch and how might shared mobility systems support public transport (**PT**) in Christchurch? My first aim was to identify what is affecting low PT usage in Christchurch and how might it change in the future. The second aim was to identify the perceptions towards shared mobility and discuss shared mobility's potential in supporting PT.

I carried out this research by interviewing policymakers who provide PT services and operators of shared mobility. I also conducted an online survey to capture public perceptions and usage of shared mobility and PT in Christchurch.

I found that low PT usage in Christchurch was affected by a number of factors, namely accessibility, frequency of service, availability of service, convenience, transport times, a poor perception of PT, the medium to low population density, the cost of PT, a culture of car dependency, the cost-effectiveness of providing PT for local authorities, and the fact that many residents live at a distance from the Central Business District. This is consistent with research from (MOT, 2017; Saroli, 2015; Borg and Ihlström, 2019; Imran, Yin and Pearce, 2015; Taylor and Fink, 2013; ITF and OCED, 2014; Stradling, Meadows & Beatty, 2000; Denne and Wright, 2016; Cooke and Behrens, 2016 and others).

I found that for my second research aim there is considerable potential for shared mobility. This is because shared mobility can be environmentally friendly, reduce congestion, be more cost-effective than owning private vehicles and reach corridors where PT cannot be efficiently provided. However, in practice, there are several barriers to the success of shared mobility. These are lack of information, concerns about the lack of safety and lack of privacy, a reluctance on the part of potential customers to use credit cards for bookings, and the limited availability of shared mobility in the locality. Again this was mostly consistent with existing research by SUMC, 2015; Atkins, 1990; Chaudhry et al., 2018; MERGE Greenwich, 2018. A new point was that customer reluctance to use a credit cards to book shared mobility services inhibits shared mobility usage. The reluctance to use credit cards suggests a lack of trust in these service providers and is likely to be connected with the relative newness of shared mobility in Christchurch.

I included in my online survey questions relating to four specific shared mobility systems: bike share, car share, ride share and ride sourcing/hailing and ride splitting. For bike share, I found that awareness and usage were relatively low. By contrast, e-scooter share was comparatively more popular. This is likely to reflect the fact that Spark Bikes, the primary bike share operator, no longer operates in Christchurch and the rise in the use of Lime-S. People were most drawn to e-scooter share by three factors: the fact that it is "easy to use", "convenience" and its "availability" in the respondent's locality.

Awareness of electrical car share (Yoogo share) was higher than awareness standard car sharing. Usage of car share was relatively low. The most appealing factors for Yoogo Share were that it is "economical", "easy to use" and "availability" in the locality. This suggests that electrical car share might be a more popular option for Christchurch residents than standard car share in the future because of its environment-friendly potential.

For ride share, I found that awareness and usage were generally low but for the Airport Shuttle service awareness and usage was higher. The most appealing factors for Airport Shuttle were; "economical", "easy to use" and "convenience".

For ridesourcing/hailing and ride splitting awareness and usage were generally low. However, Uber had the highest awareness and usage in the Christchurch community. The most appealing factors for Uber were that it is economical, convenient and available in the locality.

I cannot conclusively say on the basis of the study that shared mobility will definitely support PT in the future. The overall use and awareness of shared mobility are low. However, the rise of Lime-S (e-scooter share) and increase in Uber (ride sourcing) usage has the potential to bring greater awareness of shared mobility and popularise the use of other forms of shared mobility. The possibility of an app-based on-demand Mobility as a Service system creates the opportunity for integrating access to shared mobility with access to PT and therefore increase shared mobility's role in supporting PT.

The research overall reveals that shared mobility needs to become more established in Christchurch to increase awareness about transport options. It will need to find ways to overcome the challenges posed by a medium to a low population density of

Christchurch. Further research is recommended for how shared mobility will be effective in corridors of Christchurch where low population density or spatial distance prevents PT from being effective.

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Appendices

Appendix A: Interview Information sheet (2 pages in total)

Geography
Telephone: **021982211**
Email: **wrik.mukherjee@pg.canterbury.ac.nz**
04/02/19
HEC Ref: **2018/79/LR**

Shared Mobility: The Future of Public Transport
Information Sheet for the interview participant

My name is Wrik Mukherjee and I am currently doing an MSc at the University of Canterbury in the Geography department on transport. My research aims to find out what factors are influencing low public transport usage in Christchurch. The research will also look at different forms of shared mobility systems from around New Zealand which are specifically aimed at Christchurch to see what roles such system may play to in the future.

You have been approached to take part in this study because:

1. You fit the desired category of being a policy-maker in the current transport sector with the power to change the current transport system.

   Or

2. You currently run one of the chosen forms of shared mobility systems desired for the study.

If you choose to take part in this study, your involvement in this project will be an interview with set questions about the study. The interview will take around 30 to 45 minutes and will be recorded for the purpose of review after completion of the initial interview. All interviews will be confidential and the interview will only proceed if the consent form has been signed and accepted for the study.

In the performance of the tasks and application of the procedures, there are minimal risks of mental/emotional stress or distress, moral or cultural offence. However, to avoid these issues the flexibility of choice is given to the participant, they have the power to answer any question they feel comfortable with and avoid any they feel uncomfortable with.

Participation is voluntary and you have the right to withdraw at any stage without penalty. You may ask for your raw data to be returned to you or destroyed at any point. If you withdraw, I will remove information relating to you. However, once analysis of raw data starts on February 18th 2019, it will become increasingly difficult to remove the influence of your data on the results.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: your identity or your organization will not be made public without your prior consent. To ensure confidentiality, I will remove any personal information which can be used to identify the candidate. Access to the interview will be strictly forbidden to anyone except for the request for the initial candidate for a review. The only two individuals who will have access to this data will be the supervisors of the project which is Angela Curl and Simon Kingham, their contact details are provided below. The interview recordings will be kept behind a locked cabinet and a backup copy will be kept behind a password protected computer. A thesis is a public document and will be available through the UC Library.

Please indicate to the researcher on the consent form if you would like to receive a copy of the summary of

Appendix A: Interview Information sheet (2 pages in total)

the results of the project.

The project is being carried out as a requirement for a Master of Science degree by Wrik Mukherjee under the supervision of Angela Curl and Simon Kingham, who can be contacted at angela.curl@canterbury.ac.nz or simon.kingham@canterbury.ac.nz. They will be pleased to discuss any concerns you may have about participation in the project.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

If you agree to participate in the study, you are asked to complete the consent form.

Wrik Mukherjee

Appendix B: Interview Consent form

Geography
Telephone: **021982211**
Email:**wrik.mukherjee@pg.canterbury.ac.nz**

Shared Mobility: The Future of Public Transport
Consent Form for the interview participant

- ☐ I have been given a full explanation of this project and have had the opportunity to ask questions.
- ☐ I understand what is required of me if I agree to take part in the research.
- ☐ I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable.
- ☐ I understand that any information or opinions I provide will be kept confidential to the researcher, the two supervisors and that any published or reported results will not identify me or my organization personally without prior consent. I understand that a thesis is a public document and will be available through the UC Library.
- ☐ I understand that all data collected for the study will be kept in locked and secure facilities and/or in password-protected electronic form and will be destroyed after five years.
- ☐ I understand the risks associated with taking part and how they will be managed.
- ☐ I understand that if I approve the use of my organization's name that my answers may be identified by an internal person of my organization.
- ☐ I understand that I can contact the researcher Wrik Mukherjee or the supervisors Angela Curl or Simon Kingham at either angela.curl@canterbury.ac.nz or simon.kingham@canterbury.ac.nz for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch human-ethics@canterbury.ac.nz)gch
- ☐ I would like a summary of the results of the project.
- ☐ By signing below, I agree to participate in this research project.

Name:_____ Signed:_____ Date:_____

Email address *(for report of findings)*:_____

Please return this form back to the interviewer before the start of the interview.

Appendix C: Online Survey Information sheet and Consent form

Online Survey (Information Sheet and Informed Consent Form)

Informed Consent Form
You are being invited to participate in a research study. This form is intended to provide you with information about this study. The estimated length of this survey is between 10-15 minutes.

Purpose of Research
My name is Wrik Mukherjee and I am currently doing an MSc at the University of Canterbury in the Geography department on transport. This research is carried out as a part of my MSc. The project seeks to find out what factors are influencing low public transport usage in Christchurch. The project also aims to find the potential of the different forms of shared mobility systems and the role it may play in the future in bridging the gap between the falling public transport usage numbers.

Procedures
You will be asked about your attitudes, behaviours, and preferences on public transport and shared mobility.

Confidentiality
Your data will be confidential. I will maintain the absolute confidentiality of your personal information and only two supervisors will have access to any data. If an email address is provided, it will be kept separately. Further, due to the use of an anonymous link to complete the survey, your email address will be untraceable. When the results from the program are presented or published for academic purposes, there will be no participant identifying information. However, once the research is published the data will be anonymised and made publicly available immediately on the University of Canterbury's data repository. By signing below and submitting this informed consent form, you are giving permission to use the data you provided for research purposes now and for any future research.

Potential Risks and Benefits
There are no foreseeable physical risks associated with participation in the study. The data you provide will only be used for research, following strict alignment to scientific and ethical codes.

Contact Information
If you have any questions or would like additional information about this research, please contact either Angela Curl or Simon Kingham at angela.curl@canterbury.ac.nz or simon.kingham@canterbury.ac.nz.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

Statement of Consent
I have read the above information, based on the information above, I agree to participate in this study.

Appendix D: University of Canterbury Human Ethics Committee Letter of Approval (2 Pages in total)

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2018/79/LR

12 November 2018

Wrik Mukherjee
Geography
UNIVERSITY OF CANTERBURY

Dear Wrik

Thank you for submitting your low risk application to the Human Ethics Committee for the research proposal titled "Shared Mobility: The Future of Public Transport".

I am pleased to advise that this application has been reviewed and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your emails of 30th October and 8th November 2018.

With best wishes for your project.

Yours sincerely

pp. R. Robinson

Professor Jane Maidment
Chair, Human Ethics Committee

Appendix D: University of Canterbury Human Ethics Committee Letter of Approval (2 Pages in total)

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2018/79/LR Amendment 1

4 February 2019

Wrik Mukherjee
Geography
UNIVERSITY OF CANTERBURY

Dear Wrik

Thank you for your request for an amendment to your research proposal "Shared Mobility: The Future of Public Transport" as outlined in your email dated 25th January 2019.

I am pleased to advise that this request has been considered and approved by the Human Ethics Committee.

Yours sincerely

pp. R. Robinson

Dr Dean Sutherland
Chair, Human Ethics Committee

Appendix E: Interview Questions: Policymakers (3 pages in total)

Policymakers Interview Questions

Research Question	What factors are influencing low public transport usage in Christchurch and how might shared mobility systems support public transport in Christchurch? i. Identify what is affecting low public transport usage in Christchurch. ii. Identify the perceptions towards shared mobility and discuss the potential of shared mobility.
Topics to be discussed	- Public transport usage (Christchurch) - Density - Impact of social and spatial barriers - Shared Mobility - The future of public transport
Specific Questions **(P= prompts)**	1. Could you tell me a bit about your role and about this organisation? 2. How do you think the use of public transport in Christchurch when compared to other places such as Auckland or Singapore? *(p-a 2)* 3. If you think that public transport is higher and lower in Christchurch, what factors influence this higher and lower usage 4. Is the current transport system cost-efficient in Christchurch for (*name organisation*)? 5. What do you define as success in public transport usage? 6. What are some "key ingredients" that you believe are necessary for the success or failure of the public transport system in a city like Christchurch? 7. Would you describe Christchurch as a medium or low-density city? 8. What role if any do you believe density plays in public transport usage?

Appendix E: Interview Questions: Policymakers (3 pages in total)

	9. What role if any do you believe social or spatial barriers are playing in affecting current usage rates? *(p-c 9)* 10. How do you plan to attract more users to public transport? 11. Do you think your plan address the factors you have identified above? 12. What do you understand about shared mobility? *(p-d 12)* 13. Have you considered "shared mobility" in Christchurch? 14. Do you believe shared mobility address any of the problems associated with transport or the environment such as car congestion or lowering C02 emissions? 15. What are some barriers to implementing shared mobility systems in Christchurch? *(p-e 15)* 16. Is there any research gaps or something that is currently missing which is preventing you from moving towards shared mobility? 17. Where do you see public transport in Christchurch over the next 30 years and do you see shared mobility playing a role?
Prompts (P= prompts, a=question, x= number between questions to apply prompt)	(a 2) - Do you agree that public transport usage is lower than pre earthquake levels in Christchurch? (before 2010) (b 8) – By density, I mean city density. Academic research suggests that the higher the population the better public transport runs due to the higher number of population in close proximity. (c 9) – For social barriers, I mean things like, socioeconomic or health status. While spatial barriers are like environment restrictions such as less accessibility or availability for an individual. (d 12) - *(Defined)* Shared Mobility allows users to gain "short-term access" to different modes of transport to get from one place to another "on a need basis" (Shaheen et al., 2015). There are many systems that are categorized under the concept: • Bike-Share • Car-Share

Appendix E: Interview Questions: Policymakers (3 pages in total)

	• Ride-Share • Ridesourcing/Ride-Splitting (e 15) – These barriers can be legal / regulatory or social such us people wanting to travel by car more often.

Appendix F: Interview Questions: Operators (2 pages in total)

Operators Interview Questions

Research Question	What factors are influencing low public transport usage in Christchurch and how might shared mobility systems support public transport in Christchurch? i. Identify what is affecting low public transport usage in Christchurch. ii. Identify the perceptions towards shared mobility and discuss the potential of shared mobility.
Topics to be discussed	- Shared Mobility (SM) - The role of Christchurch in SM - SM and public transport effects - Density - Barriers to SM - The future of SM
Specific Questions **(P= prompts)**	1. Could you tell me a bit about your role and about this service? 2. How has this service developed over the last few years? 3. What do you understand by shared mobility? 4. How does your system fit in within the wider transport landscape? 5. What are some key differences between your systems and "traditional" public transport? 6. What proportion of Christchurch's passenger transport systems do you think is taken up by shared mobility in general? 7. Are you satisfied with the current level of shared mobility or do you think it could be bigger? 8. What factors do you think would contribute taking a bigger/smaller/ same share of public transport in Christchurch? 9. Would you describe Christchurch as a medium or low-density city? *(p-a 9)*

Appendix F: Interview Questions: Operators (2 pages in total)

	10. Do you think density has a relationship with shared mobility? 11. What effect could density have on shared mobility systems? 12. What are some of the current challenges in running a shared mobility system? 13. How do you think these challenges can be overcome? 14. How do you plan to make your shared mobility system more successful? *(p-b 14)* 15. What and how are you currently making people aware of your shared mobility service? 16. How do you plan to make people aware of your shared mobility service in the future? 17. Is there any research gaps or something that is currently missing which is preventing you from expanding? *(p-c 17)* 18. Where does (*name organisation*) see itself in Christchurch or New Zealand over the next 5-10 years? 19. Where do you think shared mobility in generally would be in 30 years in Christchurch and what role would your (*name organisation*) play in that?
Prompts (P= prompts, a=question, x= number between questions to apply prompt)	(a 9)- By density, I mean city density. Academic research suggests that the higher the population the better public transport runs due to the higher number of population in close proximity. (b 14) - What are you trying to achieve as a company? What's the purpose? (c 17) – Any unknowns or uncertainties, which I can perhaps help to answer in my survey.

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Shared Mobility: The Future of Public Transport

Start of Block: Public Transport Section

Information **Shared Mobility: The Future of Public Transport - Online Survey**
Ref: HEC 2018/79/LR

Informed Consent Form
You are being invited to participate in a research study. This form is intended to provide you with information about this study. The estimated length of this survey is between 10-15 minutes approximately.

Purpose of Research
My name is Wrik Mukherjee and I am currently doing an MSc at the University of Canterbury in the Geography department on transport. This research is carried out as a part of my MSc. The project seeks to find out what factors are influencing low public transport usage in Christchurch. The project also aims to find the potential of the different forms of shared mobility systems and the role it may play in the future in bridging the gap between the falling public transport usage numbers.

Procedures
You will be asked about your attitudes, behaviours and preferences on public transport and shared mobility.

Confidentiality
Your data will be confidential. I will maintain the absolute confidentiality of your personal information and only two supervisors will have access to any data. If an email address is provided, it will be kept separately. Further, due to the use of an anonymous link to complete the survey, your email address will be untraceable. When the results from the program are presented or published for academic purposes, there will be no participant identifying information. However, once the research is published the data will be anonymized and made publicly available immediately on the University of Canterbury's data repository. By signing below and submitting this informed consent form, you are giving permission to use the data you

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Contact Information
If you have any questions or would like additional information about this research, please feel free to contact Wrik Mukherjee at wrik.mukherjee@pg.canterbury.ac.nz. If you have any concerns please contact either Angela Curl or Simon Kingham at angela.curl@canterbury.ac.nz or simon.kingham@canterbury.ac.nz.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

Statement of Consent
I have read the above information, based on the information above, I agree to participate in this study.

▼ I agree to take part ... I do not wish to proceed

Skip To: End of Survey If Shared Mobility: The Future of Public Transport - Online Survey Ref: HEC 2018/79/LRInformed Cons... = I do not wish to proceed

Page Break

Important: The following section asks questions about general transport and public transport. Public transport is the system of different vehicles such as buses and trains, which is available for the general public to use on a daily basis. However, such systems usually operate on a fixed schedule and require a fare.

Examples: Buses, Trains, Ferries

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Q1 Indicate the frequency you use the following for daily travel?
(Tick all that apply)

	Most Days	3-4 times per week	1-2 times per week	Once a Month	Never
Car	○	○	○	○	○
Bus	○	○	○	○	○
Bike	○	○	○	○	○
E-bikes	○	○	○	○	○
Walking	○	○	○	○	○
Motorbike/Scooter	○	○	○	○	○
Taxi	○	○	○	○	○
Uber, Yoogo etc.	○	○	○	○	○
E-Scooter	○	○	○	○	○
Lime-S	○	○	○	○	○
Other (please explain)	○	○	○	○	○

Page Break

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Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Display This Question:

If Indicate the frequency you use the following for daily travel?(Tick all that apply) = Bus [Never]

Q2 What were your reasons for not using public transport in the last 3 months?
(Tick all the apply)

- ☐ Service is unreliable
- ☐ Service is to slow
- ☐ Services aren't frequent
- ☐ Service is not available in my area or too far away
- ☐ Buses are too crowded
- ☐ Current bus routes don't suit me
- ☐ Buses or stations are dirty
- ☐ Too expensive
- ☐ Don't want to use it
- ☐ Other (please explain) _____

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Q3 How do you feel about using Public Transport?

- ○ Mostly Positive - I love using it
- ○ Positive - I enjoying using it
- ○ Neutral - I find it reasonable but I use other alternatives when more convenient
- ○ Negative- I dislike using it
- ○ Mostly Negative - I dislike using it and would not consider it

Page Break

Display This Question:

If How do you feel about using Public Transport? = Neutral - I find it reasonable but I use other alternatives when more convenient

Or How do you feel about using Public Transport? = Negative- I dislike using it

Or How do you feel about using Public Transport? = Mostly Negative - I dislike using it and would not consider it

Q4 What if anything would make you consider using public transport more often? (Rank the following by dragging your choices)

(1- Being the most favourable and 7- Being the least favourable)

_____ Higher frequency of options (e.g more Buses and Bus routes)
_____ More bus stops
_____ Central location for more information about choices available to you (e.g. an app with all the information)
_____ Better accessibility to public transport
_____ Cheaper costs
_____ Closer to home
_____ Other (please explain)

Page Break

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Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

End of Block: Public Transport Section

Start of Block: Shared Mobility Section

Q5 Have you heard of term Shared Mobility?

- ○ Yes
- ○ No

Page Break

Q6 Have you heard of any of the following?
(Tick all that apply)

	Yes	Never Heard
Ride-Sharing	○	○
Bike-Sharing	○	○
E-Scooter Share	○	○
Car-Sharing	○	○
Ridesourcing/ Ride-Hailing or Ride-Splinting	○	○
Other (please explain)	○	○

Page Break

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Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Important: The following section is about Shared Mobility. Shared Mobility allows users to gain "short-term access" to different modes of transport to get from one place to another "on a need basis" (Shaheen et al., 2015).

There are many systems that are categorized under this concept but here are the primary examples :

- Bike-Share
- Car-Share
- Ride-Share
- Ridesourcing/Ride-Hailing or Ride-Splitting

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Important: **Bike-Share** allows users to rent a bike in an "hourly" or "daily" fashion for a small fee. Bike-Share systems generally use dock-based stations that are scattered throughout the service area for users to use and return to a station. However recently new forms of "dockless or GPS" based systems are allowing users to lock their bikes after usage within the service area without having to return it to any docking station.

(Image: Iain McGregor/Stuff.co.nz, 2018)

Q7 Have you ever used any of the following?

	Have used and I am a current member	Have used in the past	Never used
Spark Bikes	○	○	○
Onzo	○	○	○
Lime-S	○	○	○
Other (please explain)	○	○	○

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Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Q8 Are any of the following available in your area?

	Available	Not Available	I don't know
Spark Bikes	○	○	○
Onzo	○	○	○
Lime-S	○	○	○

Display This Question:

If Are any of the following available in your area? = Spark Bikes [Not Available]

Or Are any of the following available in your area? = Onzo [Not Available]

Or Are any of the following available in your area? = Lime-S [Not Available]

Or Are any of the following available in your area? = Spark Bikes [I don't know]

Or Are any of the following available in your area? = Onzo [I don't know]

Or Are any of the following available in your area? = Lime-S [I don't know]

Q8(a) Would you consider using "Spark Bikes" or "Onzo" or "Lime-S" or if these were available in your area?

- ○ Yes
- ○ Maybe
- ○ No

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Important: **Car-Share** is similar to Bike-Share as it essentially allows users to access vehicles on an hourly basis. The two most used forms of car sharing are the traditional form of car sharing, which is known as "round-trip" that allows users to borrow the vehicle but it's also expected that they return the vehicle at the same location. The other is "point-to-point" which requires users to pick up the vehicle at one spot and return it to another.

(Image: Heart of the City, 2015)

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Q9 Have you ever used any of the following?

	Have used and I am a current member	Have used in the past	Never used
Yoogo Share	○	○	○
Yourdrive	○	○	○
Cityhop	○	○	○
Other (please explain)	○	○	○

Q10 Are any of the following available in your area?

	Available	Not Available	I don't know
Yoogo Share	○	○	○
Yourdrive	○	○	○
Cityhop	○	○	○

Display This Question:

If Are any of the following available in your area? = Yoogo Share [Not Available]

Or Are any of the following available in your area? = Yourdrive [Not Available]

Or Are any of the following available in your area? = Cityhop [Not Available]

Or Are any of the following available in your area? = Yoogo Share [I don't know]

Or Are any of the following available in your area? = Yourdrive [I don't know]

Or Are any of the following available in your area? = Cityhop [I don't know]

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Q10 (a) Would you consider using "Yoogo Share" or "Cityhop" or "Yourdrive" if these were available in your area?

- ○ Yes
- ○ Maybe
- ○ No

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Important: **Ride-Share** can be simplified to allow users to add passengers to their "pre-existing trips". There are a few different types of ride sharing systems but the most used are carpooling, vanpooling and real-time dynamic ridesharing. Carpooling allows travelers to ride together to save fuel and operating cost. Vanpooling generally is run by public transit systems, it allows a group of users to travel together, and is often aimed at co-workers. Finally, there is real-time dynamic ridesharing, which allows drivers and passengers to match on an online app based on their destination before the trip starts.

(Image: Future Five NZ, 2017)

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Q11 Have you ever used any of the following?

	Have used and I am a current member	Have used in the past	Never used
SAVY	○	○	○
Driving Miss Daisy	○	○	○
GOVbus	○	○	○
Greencab	○	○	○
Airport Shuttle	○	○	○
Other (please explain)	○	○	○

Q12 Are any of the following available in your area?

	Available	Not Available	I don't know
SAVY	○	○	○
Greencab	○	○	○
Driving Miss Daisy	○	○	○
Airport Shuttle	○	○	○
GOVbus	○	○	○

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Display This Question:

If Are any of the following available in your area? = SAVY [Not Available]

Or Are any of the following available in your area? = Driving Miss Daisy [Not Available]

Or Are any of the following available in your area? = Greencab [Not Available]

Or Are any of the following available in your area? = Airport Shuttle [Not Available]

Or Are any of the following available in your area? = GOVbus [Not Available]

Or Are any of the following available in your area? = SAVY [I don't know]

Or Are any of the following available in your area? = Driving Miss Daisy [I don't know]

Or Are any of the following available in your area? = Greencab [I don't know]

Or Are any of the following available in your area? = Airport Shuttle [I don't know]

Or Are any of the following available in your area? = GOVbus [I don't know]

Q12(a) Would you consider using "SAVY" or "Greencab" or "Driving Miss Daisy" or "Airport Shuttle" or "GOVbus" if these were available in your area?

- ○ Yes
- ○ Maybe
- ○ No

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Important: **Ridesourcing/Ride-Hailing** or **Ride-Splitting** is the role of Uber and Lyft, which allows their users to connect with their drivers through the online app and the drivers generally use a personal vehicle. While ride-splitting falls under the same category, it's slightly different as the passengers split the cost between each other or other riders on the same route.

(Image: Digital Trends, 2018)

Q13 Have you ever used any of the following?

	Have used and I am a current member	Have used in the past	Never used
Uber	○	○	○
Ola	○	○	○
Zoomy	○	○	○
Other (please explain)	○	○	○

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Q14 Are any of the following available in your area?

	Available	Not Available	I don't know
Uber	○	○	○
Ola	○	○	○
Zoomy	○	○	○

Display This Question:

If Are any of the following available in your area? = Uber [Not Available]

Or Are any of the following available in your area? = Ola [Not Available]

Or Are any of the following available in your area? = Zoomy [Not Available]

Or Are any of the following available in your area? = Uber [I don't know]

Or Are any of the following available in your area? = Ola [I don't know]

Or Are any of the following available in your area? = Zoomy [I don't know]

Q14(a) Would you consider using "Uber" or "Ola" or "Zoomy" if it was available?

- ○ Yes
- ○ Maybe
- ○ No

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

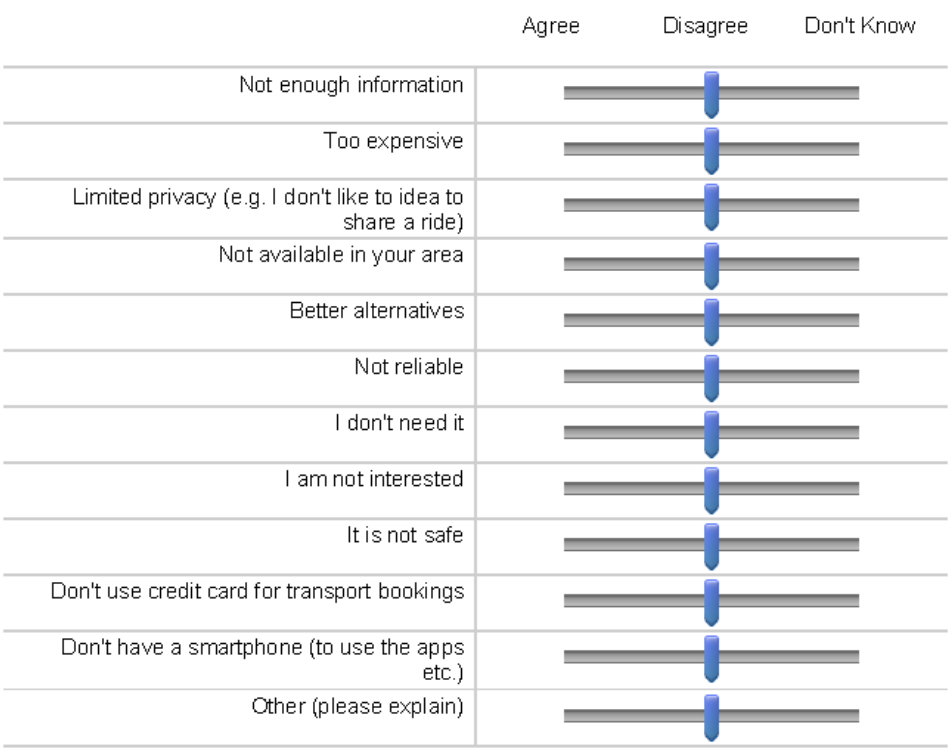
Q15 What reasons have motivated you to use these different forms of transport?
(Tick all that apply)

	Uber	Yoogo Share	Spark Bikes	SAVY	Yourdrive	Zoomy	Cityhop	Ola	Lime-S	Driving Miss Daisy	Airport Shuttle
Economical	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Easy to use	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Convenience	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Availability in my area	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Speed of service	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Flexibility to customize your ride	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Parking is to expensive	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
To use my phone or computer during the trip	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tried it overseas	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other (please explain)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Q16 Are any of the following factors preventing you from using different forms of shared mobility?
(Use the slider)



Page Break

Q17 Have you ever had a smartphone?

- ○ Yes
- ○ No

Skip To: End of Block If Have you ever had a smartphone? = No

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Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Page Break

Q18 Have you ever used any of the followings apps for navigation?
(Tick all that apply)

- ☐ Google Maps
- ☐ Apple Maps
- ☐ Waze
- ☐ Bing Maps
- ☐ MapQuest
- ☐ Maps.Me
- ☐ HERE WeGO
- ☐ Other (please explain) _____

End of Block: Shared Mobility Section

Start of Block: Personal Question Section

Important: The last section includes some demographic and lifestyle questions to make sure the survey gathers a wide range of people in our sample. Please be assured that your answers are confidential and only used for the purpose of this research.

Page Break

Q19 What is your postcode?

Note: The postcode is not being used to identify you or will not be used to track you in any manner it is simply being used to identify what forms of public transport options are available in your area.

_____

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Q20 To which gender identity do you most identify?

- ○ Male
- ○ Female
- ○ Other (Not Listed)

Page Break

Q21 Which age categories do you fall under?

- ○ Under 20
- ○ 21-30
- ○ 31-40
- ○ 41-50
- ○ 51-60
- ○ 61-70
- ○ 71 -80
- ○ 81+

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Q22 What is your occupation?

- ○ Employed (Full Time)
- ○ Employed (Part Time)
- ○ Self Employed
- ○ Unemployed
- ○ Student
- ○ Retired

Page Break

Q23 How many personal vehicles motor vehicles do you currently own in household?

- ○ None
- ○ 1
- ○ 2
- ○ 3+

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Q24 What is your current household income before tax on a yearly basis?

- ○ Below $1000
- ○ $1000-10,000
- ○ $10,000-20,000
- ○ $20,000-30,000
- ○ $30,000-40,000
- ○ $40,000-50,000
- ○ $50,000-60,000
- ○ $60,000-70,000
- ○ $70,000-80,000
- ○ $80,000-90,000
- ○ $90,000-100,00
- ○ $100,000-110,000
- ○ $110,000-120,000
- ○ $120,000-130,000
- ○ $130,000-140,00
- ○ $140,000-150,00
- ○ $150,000 +
- ○ I don't know
- ○ Prefer not to answer

Page Break

Appendix G: Shared Mobility: Online Survey Questions (24 pages in total)

Important End

Thank you for completing the survey if you have any further questions please feel free to contact me: *wrik.mukherjee@pg.canterbury.ac.nz*

If you are interested in the final results and would like a summary of the results please leave your email address below.

The email address will only be used to deliver a summary of the results to the interested respondent and will not be used for any other matter.

Important End **Insert email address here**

_____

End of Block: Personal Question Section

Appendix H: Raw Data: Online Survey Question (9 Pages in total)

#	Answer	%	Count
1	I agree to take part	99.04%	103
2	I do not wish to proceed	0.96%	1
	Total	100%	104

Q1 - Indicate the frequency you use the following for daily travel?

#	Question	Most Days		3-4 times per week		1-2 times per week		Once a Month		Never		Total
1	Car	**39**	39	**13**	16	**31**	26	**17**	14	**5**	5	100
2	Bus	**12**	15	**9**	11	**27**	22	**31**	26	**57**	47	121
3	Bike	**20**	19	**6**	7	**13**	11	**12**	10	**46**	46	93
4	E-bikes	**6**	5	**2**	2	**1**	1	**1**	1	**81**	81	90
5	Walking	**54**	51	**5**	6	**29**	24	**13**	11	**3**	3	95
6	Motorbike/Scooter	**0**	0	**0**	0	**2**	2	**4**	3	**87**	87	92
7	Taxi	**0**	0	**1**	1	**5**	4	**24**	20	**68**	68	93
8	Uber, Yoogo etc.	**0**	0	**1**	1	**5**	4	**29**	24	**64**	64	93
9	E-Scooter	**0**	0	**0**	0	**2**	2	**1**	1	**89**	89	92
10	Lime-S	**0**	0	**0**	0	**5**	4	**24**	20	**68**	68	92
11	Other (please explain)	**2**	1	**0**	0	**0**	0	**2**	2	**40**	40	43

Appendix H: Raw Data: Online Survey Question (9 Pages in total)

Q2 - What were your reasons for not using public transport in the last 3 months?

(Tick all the apply)

#	Answer	%	Count
1	Service is unreliable	8.51	4
2	Service is to slow	15	7
6	Services aren't frequent	12.77	6
3	Service is not available in my area or lo	8.51	4
4	Buses are too crowded	4.26	2
8	Current bus routes don't suit me	17.02	8
5	Buses or stations are dirty	2.13	1
10	Too expensive	10.64	5
9	Don't want to use it	8.51	4
7	Other (please explain)	12.77	6
	Total	100%	47

Q2_7_TEXT - Other (please explain)

Other (please explain) - Text

I can usually get to anywhere I want to go by bike, so I use that instead. Helps save money and keep up my health

Had no scope to use as own car was available all the time

Prefer to bike for any of the routes that public transport would take me

No bus service from Dunsandel or service connecting to Rolleston services.
Also even Rolleston service does not go past 8pm, which is no good for an evening in town.

I car pool and get dropped off at work and bike home.

Too short a distance to bother with. Use buses to get to city centre occasionaly

Q3 - How do you feel about using Public Transport?

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How do you feel about using Public Tra	1	4	2.36	0.83	0.7	103

#	Answer	%	Count
1	Mostly Positive - I love using it	17%	17
2	Positive - I enjoy using it	38%	39
3	Neutral - I find it reasonable but I use c	39%	40
4	Negative- I dislike using it	7%	7
5	Mostly Negative - I dislike using it and v	0.00%	0
	Total	100%	103

Q4 - What if anything would make you consider using public transport more often? (Rank the following by dragging your choices)

(1- Being the most favourable and 7- Being the least favourable)

#	Question	1		2		3		4		5		6		7		Total	
1	Higher frequency of options (e.g more t	26%	11	33.33%	14	16.67%	7	21.43%	9	2.38%	1	0.00%	0	0.00%	0	42	
2	More bus stops	14%	6	19.05%	8	11.90%	5	19.05%	8	16.67%	7	16.67%	7	2.38%	1	42	
3	Central location for more information at	7.14%	3	4.76%	2	14.29%	6	19.05%	8	23.81%	10	26.19%	11	4.76%	2	42	
4	Better accessibility to public transport	7.14%	3	16.67%	7	16.67%	7	14.29%	6	21.43%	9	16.67%	7	7.14%	3	42	
5	Cheaper costs	17%	7	14.29%	6	21.43%	9	16.67%	7	11.90%	5	11.90%	5	7.14%	3	42	
6	Closer to home	14.29%	6	9.52%	4	14.29%	6	7.14%	3	21.43%	9	28.57%	12	4.76%	2	42	
7	Other (please explain)	14.29%	6	2.38%	1	4.76%	2	2.38%	1	2.38%	1	0.00%	0	73.81%	31	42	

	1	2	3	4	5	6	7
Higher frequency of options (e.g more t	11	14	7	9	1	0	0
More bus stops	6	8	5	8	7	7	1
Central location for more information a	3	2	6	8	7	7	2
Better accessibility to public transport	3	7	7	6	9	7	3
Cheaper costs	7	6	9	7	5	5	3
Closer to home	6	4	6	3	9	12	2
Other (please explain)	6	1	2	1	1	0	31

Q5 - Have you heard of term Shared Mobility?

#	Answer	%	Count
1	Yes	39.4	40
2	No	62.61	63
	Total	100%	103

Q6 - Have you heard of any of the following?

#	Question	Yes		Never Heard		Total
1			Yes		Never Heard	
2	Ride-Sharing	87.85	88	14.15	15	103
3	Bike-Sharing	64.63	65	37.37	38	103
4	E-Scooter Share	64.63	65	37.37	38	103
5	Car-Sharing	93.91	94	8.09	9	103
6	Ridesourcing/ Ride-Hailing or Ride-Spli	24.24	25	77.76	78	103
	Other (please explain)	13.04%	3	86.96%	20	23

Appendix H: Raw Data: Online Survey Question (9 Pages in total)

Q7 - Have you ever used any of the following?

#	Question	Have used and I am a current member		Have used in the past		Never used		Total
1	Spark Bikes	3	3	23	24	73.79	76	103
2	Onzo	2	2	1.94	2	96	99	103
3	Lime-S	16	16	25	26	59.22	61	103
4	Other (please explain)	0.00%	0	3.03%	1	96.97%	32	33

Q8 - Are any of the following available in your area?

#	Question	Available		Not Available		I don't know		Total
1	Spark Bikes	15.53	16	35.92	37	49	50	103
2	Onzo	3.88	4	35.92	37	60	62	103
3	Lime-S	71	73	15.53	16	13.59	14	103

Q8(a) - Would you consider using "Spark Bikes" or "Onzo" or "Lime-S" or if these were available in your area?

#	Answer	%	Count
1	Yes	38	39
2	Maybe	40	41
3	No	22	23
	Total	100%	103

Q9 - Have you ever used any of the following?

#	Question	Have used and I am a current member		Have used in the past		Never used		Total
1	Yoogo Share	6	6	8	8	86.41	89	103
2	Yourdrive	0.00	0	1.94	2	98	101	103
3	Cityhop	0.00	0	3.88	4	96	99	103
4	Other (please explain)	3.13%	1	9.38%	3	87.50%	28	32

Q10 - Are any of the following available in your area?

#	Question	Available		Not Available		I don't know		Total
1	Yoogo Share	39	40	15.53	16	45.63	47	103
2	Yourdrive	0.97	1	23.30	24	76	78	103
3	Cityhop	0.97	1	26.21	27	73	75	103

Q10 (a) - Would you consider using "Yoogo Share" or "Cityhop" or "Yourdrive" if these were available in your area?

#	Answer	%	Count
1	Yes	29	30
2	Maybe	32	33

Appendix H: Raw Data: Online Survey Question (9 Pages in total)

3	No	39	40					
	Total	100%	103					

Q11 - Have you ever used any of the following?

#	Question	Have used and I am a current member		Have used in the past		Never used		Total
1	SAVY	0.00	0	2.91	3	97	100	103
2	Driving Miss Daisy	0.00	0	1.94	2	98.06	101	103
3	GOVbus	0.00	0	2.91	3	97.09	100	103
4	Greencab	0.00	0	31	32	68.93	71	103
5	Airport Shuttle	3	3	73	75	24.27	25	103
6	Other (please explain)	0.00%	0	7.14%	2	92.86%	26	28

Q12 - Are any of the following available in your area?

#	Question	Available		Not Available		I don't know		Total
1	SAVY	0.00	0	17.48	18	83	85	103
2	Greencab	38	39	13.59	14	48.54	50	103
3	Driving Miss Daisy	47	48	10.68	11	42.72	44	103
4	Airport Shuttle	79	81	3.88	4	17.48	18	103
5	GOVbus	3.88	4	10.68	11	85	88	103

Q12(a) - Would you consider using "SAVY" or "Greenoab" or "Driving Miss Daisy" or "Airport Shuttle" or "GOVbus" if these were available in your area?

#	Answer	%	Count
1	Yes	38	39
2	Maybe	44	45
3	No	18	19
	Total	100%	103

Q13 - Have you ever used any of the following?

#	Question	Have used and I am a current member		Have used in the past		Never used		Total
1	Uber	30	31	29	30	40.78	42	103
2	Ola	1	1	12	12	87	90	103
3	Zoomy	1	1	10	10	89	92	103
4	Other (please explain)	0.00%	0	3.33%	1	96.67%	29	30

Q14 - Are any of the following available in your area?

#	Question	Available		Not Available		I don't know		Total
1	Uber	89	92	0.97	1	9.71	10	103
2	Ola	33.01	34	8.74	9	58	60	103
3	Zoomy	17.48	18	5.83	6	77	79	103

Q14(a) - Would you consider using "Uber" or "Ola" or "Zoomy" if it was available?

#	Answer	%	Count
1	Yes	42	43
2	Maybe	36	37
3	No	22	23
	Total	100%	103

Appendix H: Raw Data: Online Survey Question (9 Pages in total)

Q16 - What reasons have motivated you to use these different forms of transport?

(Tick all that apply)

#	Question	Uber		Yoogo Share		Spark Bikes		BAIY		Yourdrive		Zoomy		Qhop		Ola		Lime-S		Driving Miss Daisy		Airport Shuttle		GO!Bus		Total	
1	Economical	27%	42	6%	9	5%	8	2%	3	1%	2	3%	5	0.65%	1	7%	10	13.73%	21	0.65%	1	32%	49	1.31%	2	153
2	Easy to use	26.47%	39	5.11%	7	5.11%	7	0.73%	1	0.00%	0	2.19%	3	1%	2	6.57%	9	29%	35	1.46%	2	29.36%	32	0.00%	0	137
3	Convenience	33%	42	4.72%	6	5.51%	7	1.57%	2	0.00%	0	0.00%	0	0.79%	1	4.72%	6	22.05%	28	1.57%	2	23.62%	30	2%	3	127
4	Availability in my area	33.33%	40	5.83%	7	4.17%	5	0.00%	0	0.83%	1	0.83%	1	0.83%	1	5.83%	7	22.50%	27	3%	4	21.67%	26	0.83%	1	120
5	Speed of service	37.08%	33	5.62%	5	3.37%	3	0.00%	0	0.00%	0	1.12%	1	1.12%	1	8.99%	8	22.47%	20	1.12%	1	15.10%	17	0.00%	0	89
6	Flexibility to customize your ride	31.94%	23	6.94%	5	5.56%	4	0.00%	0	0.00%	0	0.00%	0	2.78%	2	4.17%	3	31.94%	23	1.39%	1	13.89%	10	1.39%	1	72
7	Parking is too expensive	22.58%	14	9.68%	6	4.84%	3	3.23%	2	1.61%	1	0.00%	0	1.61%	1	1.61%	1	17.74%	11	0.00%	0	37.10%	23	0.00%	0	62
8	To use my phone or computer during tr	39.47%	15	5.26%	2	0.00%	0	2.63%	1	0.00%	0	0.00%	0	2.63%	1	18.42%	7	5.26%	2	0.00%	0	23.68%	9	2.63%	1	38
9	Tried it overseas	37.50%	15	0.00%	0	10.00%	4	0.00%	0	0.00%	0	2.50%	1	0.00%	0	15.00%	6	2.50%	1	0.00%	0	30.00%	12	2.50%	1	40
10	Other (please explain)	25.00%	2	12.50%	1	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	25.00%	2	0.00%	0	37.50%	3	0.00%	0	8

Q18 - Are any of the following factors preventing you from using different forms of shared mobility?

(Use the slider)

#	Field	Count	
1	Not enough information	101	1
2	Too expensive	79	
3	Limited privacy (e.g. I don't like to idea to share a ride)	94	3
4	Not available in your area	81	5
5	Better alternatives	79	
6	Not reliable	79	
7	I don't need it	73	
8	I am not interested	76	
9	It is not safe	98	2
10	Don't use a credit card for transport bookings	87	4
11	Don't have a smartphone (to use the apps etc.)	5	
12	Other (please explain)	10	

Appendix H: Raw Data: Online Survey Question (9 Pages in total)

Q16_6_TEXT - Other (please explain)

Other (please explain) - Text
I have family of five, I commute with them each day. Taxis or on demand options are too small and I have multiple drop offs and pick ups each trip, buses don't go where I need to go
health risk factor is not yet properly addressed for e-scooters and e-bikes
More availability
Prefer using my ebike
Some of the services are new, not very visible, and I haven't got around to it yet in a busy life.
Concerns over sharing of personal information, hacking, or lack of security of personal information
I prefer the public transport system we have.
Car-based transport is harmful, Uber etc are horrible to workers
Regulation
I cycle most places.
bike and own car work well for me except when going to airport with whole family
have other options available to me

Q17 - Have you ever had a smartphone?

#	Answer	%	Count
1	Yes	96.12	99
2	No	3.88	4
	Total	100%	103

Q18 - Have you ever used any of the followings apps for navigation?

(Tick all that apply)

#	Answer	%	Count
1	Google Maps	62.26	99
2	Apple Maps	16.98	27
3	Waze	6.29	10
6	Bing Maps	4.40	7
4	MapQuest	2.52	4
5	Maps.Me	4.40	7
7	HERE WeGO	1.26	2
8	Other (please explain)	1.89	3
	Total	100%	159

Q18_8_TEXT - Other (please explain)

Other (please explain) - Text
There have been a lot of these services including maps and actual journey planners over the years
Pilot app
Sygic

Appendix H: Raw Data: Online Survey Question (9 Pages in total)

Bygic
Q18 - What is your postcode?
8062
8011
8042
8034
8013
8081
8034
8024
8022
9016
8062
8041
8082
8062
8014
8082
7430
8062
8041
7514
8013
8053
8014
8042
8083
8081
8041
8053
8042
8140
8011
8011
8022
8013
8014
7608
6037
8025
8042
8042
8042
8034
6011
8013
6011
8024
7471
8042
8081
8014
8041
8053
8011
8042
8011
8013
7481

Appendix H: Raw Data: Online Survey Question (9 Pages in total)

8024				
8051				
8053				
8011				
8011				
7610				
8042				
8011				
8061				
7682				
7159				
8013				
5013				
8014				
8013				
8051				
8023				
8051				
8041				
8013				
8083				
7692				
8022				
8013				
8025				
8025				
7614				
8011				
8025				
7400				
8023				
8052				
8042				
8022				
8041				
8082				
8082				
7670				
8041				
8022				
8081				
8971				
8052				
8083				
8053				
7678				
Q20 - To which gender identity do you most identify?				
#	Answer	%	Count	
1	Male	45	46	
2	Female	54	56	
3	Other (Not Listed)	1	1	
	Total	100%	103	

Appendix H: Raw Data: Online Survey Question (9 Pages in total)

Q21 - Which age categories do you fall under?

#	Answer	%	Count
1	Under 20	9	9
2	21-30	22	23
3	31-40	17	17
4	41-50	23	24
5	51-60	16	16
6	61-70	13	13
7	71 -80	1	1
8	81+	0	0
	Total	100%	103

Q22 - What is your occupation?

#	Answer	%	Count	
1	Employed (Full-Time)	45	45	
2	Employed (Part-Time)	24	24	
3	Self Employed	8	8	
4	Unemployed	5	5	
5	Student	11	11	
6	Retired	8	8	
	Total	100%	101	(2 skipped)

Q23 - How many personal motor vehicles do you currently own in the household?

#	Answer	%	Count
1	None	10.68	11
2	1	35.92	37
3	2	34.95	36
4	3+	18.45	19
	Total	100%	103

Q24 - What is your current household income before tax on a yearly basis?

#	Answer	%	Count
1	Below $1000	1.0	1
2	$1000-10,000	2.9	3
3	$10,000-20,000	8.7	9
4	$20,000-30,000	3.9	4
5	$30,000-40,000	1.0	1
6	$40,000-50,000	4.9	5
7	$50,000-60,000	3.9	4
8	$60,000-70,000	8.7	9
9	$70,000-80,000	5.8	6
10	$80,000-90,000	2.9	3
11	$90,000-100,00	4.9	5
12	$100,000-110,000	5.8	6
13	$110,000-120,000	2.9	3
14	$120,000-130,000	1.9	2
15	$130,000-140,00	1.0	1
16	$140,000-150,00	1.9	2
17	$150,000 +	10.7	11
19	I don't know	14.56	15
18	Prefer not to answer	12.62	13
	Total	100%	103

Appendix I: Regional Public Transport Plan 2018-2028: Top Priorities (ECAN, 2018 pg. 2)

Our top priorities, over the next ten years, are:

- **Improving our environment:** Increase the number of people using public transport and reduce the carbon footprint of public transport by shifting to zero emission vehicles.
- **Growing patronage:** Greater priority on high demand routes and a high-quality travel experience. As the population grows, rapid transit may be added to improve travel times along key corridors to and from the city.
- **Accessibility:** Provide more frequent public transport services so that more people can get to workplaces, shopping, education and recreation within 30 minutes.
- **Innovation:** Trial and introduce new transport and technology initiatives with lower environmental impacts, greater safety and lower costs.
- **Affordability:** Expand the network at a rate the community can afford, with cost effective new services and infrastructure that is financially sustainable for ratepayers and funding agencies.